The Meteorological Magazine

Vol. 65

(Eleventh of the New Series)

1930

Published by the Authority of the Meteorological
Committee. Air Ministry. Meteorological Office.

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE.
To be purchased through any Bookseller or directly from
H.M. STATIONERY OFFICE at the following addresses:
ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH;
YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF;
15, DONEGALL SQUARE WEST, BELFAST.

5'0D

INDEX

PAGE
Aberdeen, Observation of the green ray at 6
Absalom, H. W L., Wet bulb thermometers 95
Air current, Abnormal vertical... 65
— —, Downward 139
Air movement, Rhythmic changes 92
Algué, J. 147,170
America, Climate and weather of the Middle Eocene in western 266
— Drought in North ... 180,215
— Storm of snow and ice in ... 15
Arc, Halo into circumzenithal ... 188
Arctic expedition 75
Ashmore, S. E., Colouring of evening sky 14
—, Drifting of London fog ... 89
—, Halo phenomena in false cirrus 187
—, Percolation at Grayshott ... 40
Athens, Annals of the National Observatory of 20
Atlantic ship observations and Mediterranean forecasting ... 18
—, Unusually red sunrises and sunsets over the 154
Atlas of Japan, Climatic 72
Atmosphere as a colloid 66
Audibility, Unusual 14
Aurén, T. E., Illumination from sun and sky 257
Austria, Medical climatology in... 166

Bahamas, Hurricane at the ... 44
Bamford, A. J., Design of rain gauges for tropical use ... 81
—, Downward air currents ... 139
Banerji, S. K., Electric field of overhead thunderstorms ... 87
Banks, F. C., Display of mock-suns 114
Barcelona, Commemoration ceremony at 118
Barlow, E. W., Sea disturbance and surface temperature (review) 20
—, Sea-surface temperatures in the Malay Archipelago (review) 49

PAGE
Bauer, L. A. 23
Baxendell pen, Rounded 261
Belasco, J. E., Thunderstorm, August 29th-30th, 1930 ... 185
—, and E. G. Bilham, Wind force and thermometer readings on board ship 184
Berlage, H. P., Sea-surface temperatures in the Malay Archipelago (review) ... 49
Best, A. C., Instruments for obtaining dry and wet bulb temperatures 113
Bigg, W. H., Range of visibility in a fog 264
Bilham, E. G., Glazed frost? ... 285
—, and J. E. Belasco, Wind force and thermometer readings on board ship 184
Biscay, Isobaric distribution and weather in the Bay of ... 193
Blair, E. W., Red rainbow ... 13
Bliss, E. W., Indian Meteor. Dept., Scientific Notes, Vol 1, Nos. 4-6 (review) 145
—, Long-range weather forecasting (review) 74
—, Nile floods (review) 98
Bogota 1927, Annals of the Observatory at 50
Bonacina, L. C. W., Northumberland thunderstorm 212
Books received 22,50,75,120,169, 194,218,242
Bora at Split, Dalmatia 116
Botley, C. M., Drought in North America 215
—, Halo and parhelia 67
—, Observation of the green ray 8
—, Weather lore of Normandy ... 90
Bowering, D. F., and W. H. Pick, Minimum temperatures on " radiation nights " 66
Braak, C., Climate of the Netherlands (review) 166
British Association for the Advancement of Science, Bristol 201
British waters, Waterspouts in ... 38

PAGE

Brooks, C. E. P., Climate (review) 46
—, Climate and weather of the Middle Eocene 266
—, Climate of the first half of the eighteenth century 136
—, Manual of Meteorology, Vols. II and III (review) ... 105
—, Relation between sunshine and cloud 9
—, Weather of the past winter... 29
—, and S. T. A. Mirrlees, Annual variations of temperature in London 135
— — —, Meteorological results of journeys in the southern Sahara 36
Bull, G. A., Line-squall and Bora at Split, Dalmatia ... 116
Buys Ballot's Law 191

Cardington, February 25th-26th, 1930, Uunusual gustiness at 153
—, From the meteorologists at ... 236
Cave, C. J. P., Colouring of evening sky 14
—, Halo phenomena in false cirrus 214
—, Phenological report, British Isles, 1929 258
Ceylon, May, 1930, Floods ... 190
Christmas, W. D. 295
Cirrus, Halo phenomena in false 187,214
Clark, J. E., Phenological report, British Isles, 1929 258
Clark, K. G. T., and A. V. Williamson, Annual rainfall of India 259
Clarke, G. A. 219
—. Observation of green ray at Aberdeen 6
Climate, Effect of exposure on ... 140
—, Handbook for business men, students and travellers ... 46
— of Muottas-Muraigl 118
— of the first half of the eighteenth century 136
— of the Netherlands 166
Climatological Tables for the British Empire ... *monthly*
Climatology in Austria, Medical ... 166
Cloud form, Rare 186
Cloud phenomena, Peculiar 215,287
—, Relation between sunshine and 9
—, Super-cooled 286
Coles, F. E., and W. H. Pick, Waterspouts in British waters 38

PAGE

Colloid, Atmosphere as a 66
Colouring of evening sky 14
Condolence, Messages of [M. A. Giblett] 237
Cox, H. J. 51
Crete, " Willy-Nilly " in ... 117
Crichton, J., Intersecting rainbows 213
—, Waterspouts in British waters 38
Crops and weather 293
Crossley, A. F., Deutsch. Meteor. Jahrb. Bayern 1928 (review) 292
Crowquill pens, Delayed ink feed for 115
Cyclones and anticyclones 209,259,289
Cyclonic depressions of November 16th and 23rd, 1928 38
Cyprus, " Flattish " hailstones in 289
Currents, Downward air 139

Daily weather report, Changes in the 45
Dansey, R. P., Dry Junes ... 160
De Geer, G., Geochronology (review) 218
Deposit at Southport, Peculiar... 144
Depressions of November 16th and 23rd, 1928 38
Deutsch. Meteor. Jahrb. Bayern, 1928 292
Dewar, D., Statistical probability of rain in London 131
Dight, F. H., Gale of January 12th, 1930 1
—, Nephoscope observations ... 280
—, Thunderstorms of November 2nd, 1930 249
Diaries, Goodwood House, 1798-1806, Old weather 70
Dines, L. H. G., Dines balloon meteorograph 37
—, Experiments with wet-bulb thermometers 113
—. Super-cooled cloud 286
—, Temperature observations in fog at Kew 277
Doodson, A. T. 75
Doporto, M., Types of isobaric distribution and of weather in the Bay of Biscay (review)... 193
Dorno, C., Climate of Muottas-Muraigl (review) 118
Douglas, C. K. M., Cold fogs over the sea 133
—, Cyclonic depressions of Nov. 16th and 23rd, 1928 38

INDEX

PAGE

Douglas, C. K. M., Differential mechanics of "fronts" and of the isallobaric field (review) 167
—, "Gliding surfaces" and fog formation 91
—, June thunderstorms 129
—, Recent heat and thunderstorms 177
Downward air currents 139
Drought in North America 180,215
Durst, C. S., Loss of R 101 ... 226
—, Unusual gustiness at Cardington, Feb. 25th-26th, 1930 ... 153
Durward, J., Fog in lower Egypt on Oct. 29th and 30th, 1929... 68

Eckardt, W. R. 147,218
Eckener, H. 295
Egypt, Formation of fog in lower 68
Ellinger, H. E., Range of visibility in a fog 41
Entwistle, F., Life and work of M. A. Giblett 230
Eocene in western America, Climate and weather of the middle 266
Eredia, F., Meteorological-aerological station at Cape Guardafui 269
Europe, Volcanic eruptions and pressure distribution over western 39
European monsoon 73
Evaporation from rain gauges ... 161
Exner, F. M. 50
Exposure on climate, Effect of ... 140
Exposures, Drawback of leeside... 254

Fairgrieve, J., Fog of Jan. 21st, 1930 41
Fiji Islands, Hurricanes in the ... 69
Floods in Ceylon, May, 1930 ... 190
—, in southern France 43
Fog, Drifting of London 89
— formation and "gliding surfaces" 91
— in lower Egypt on Oct. 29th and 30th, 1929... 68
— of January 21st, 1930 41
—, Range of visibility in a 11,41,264
—, Temperature observations in... 277
Fogs of different depths, Frequency of 17
— over the sea, Cold 133
Fontseré, E., Commemoration ceremony at Barcelona ... 118

PAGE

Fontseré, E., Smoking sea ... 12
Forecasting, Importance of Atlantic ship observations for Mediterranean 18
—, Seasonal 112
France, Floods in southern ... 43
"Fronts," Differential mechanics of 167
Frost? Glazed 285
Frosty weather, Rain gauges in... 162

Gale in Iraq 267
Gale of January 12th, 1930 ... 1
Gales and lightning 13
Geochronology 218
Geophysics. Introduction to ... 97
Gião, A., Differential mechanics of "fronts" and of the isallobaric field (review) ... 167
Giblett, M. A. 219,225,230
Glasspole, J., Heavy falls of rain in short periods 284
—, Heavy rain of November 11th, 1929 32
—, Heavy rainfall in India (review) 269
—, Heavy rainfall near Whitby, July 20th-23rd, 1930 158
—, Indian rainfall for fifty years (review) 21
—, Rainfall of 1930 290
—, Simple equation for heavy rainfalls in short periods ... 70
—, Thunderstorm near Ilkley on April 25th, 1930 110
"Gliding surfaces" and fog formation 91
Gold, E., Cyclones and anticyclones 259
—, Glazed frost? 285
—, Range of visibility in a fog 11
Goldie, A. H. R., "Record" Gust 164
Goodwood House, 1798-1806, Old weather diaries 70
Goodyear, J. G., Unusual audibility 14
Gray Memorial Trust 75
Gray, R., Halo phenomena ... 137
Grayshott, Percolation at 40
Green ray at Aberdeen, Observation of the 6
— —, Observation of the ... 8
Greenland, Expedition to 75
Gregory, Sir R. A. 295
—, Weather cycles and weather recurrences 10

PAGE
Groissmayr, F. B., Long period weather forecasting (review)... 74
—, Nile flood and the temperature of the following winters in Leipzig (review) 98
—, Nile floods (review) 98
Guardafui, Meteorological-aerological station at Cape ... 269
Gust, "Record" 164
Gustiness at Cardington, Feb. 25th-26th, 1930, Unusual ... 153

Hailstones in Cyprus, "Flattish" 289
Hailstorm in Iraq, Remarkable... 143
Halo and parhelia 67
— into circumzenithal arc ... 188
— phenomena 137,287
— — in false cirrus ... 187,214
Halos 93
— at Kashgar 161
Harwood, W. A., Experiments with wet-bulb thermometers 113
Heat and thunderstorms, Recent 177,211
Heywood, G. S. P., Frequency of fogs of different depths ... 17
Hindu meteorology, Ancient ... 263
Hoelper, O. 147
Hongkong, Waterspout at ... 287
Hurricane at the Bahamas ... 44
——, Santo Domingo 216
Hurricanes in the Fiji Islands ... 69
Hygrograph, Accuracy of a hair... 163

Ice in America, Storm of... ... 15
Ilkley, Thunderstorm near ... 110
Illumination from sun and sky near Stockholm, 1928... ... 257
India, Annual rainfall of... ... 259
—, Heavy rainfall over short periods in 269
Indian Meteor. Dept., Scientific Notes, Vol. 1, Nos. 4-6 ... 145
— rainfall for fifty years, summary of 21
Instruments for obtaining dry and wet-bulb temperatures ... 113
International Meteorological Committee 241
Inwards, R. 99
Iraq. Gale in 267
—, Remarkable hailstorm in ... 143
—, Upper air temperature in ... 242
Irminger, J. O. V., and Chr. Nokkentved, Wind pressure on buildings (review) ... 192
Isallobaric field, Differential mechanics of the 167

PAGE
Isobaric distribution in the Bay of Biscay 193

Jameson, H., Inferior mirage at sunrise 138
Japan, Climatic Atlas of 72
Johnston, D. W., Rhythmic changes in air movement ... 92
Junes, Dry 160

Kashgar, Halos at 161
Kew, Temperature observations in fog at 277
Key, J., Waterspout at Cape d'Aguilar 287
Kidson, E., Ball lightning ... 212
—, Cyclones and anticyclones ... 289
Kites, Early episode in the meteorological employment of... 96
Knight, C. N. 271

Lapworth, H., Meteorology and water supply 64
Leeside exposures, Drawback of... 254
Lightning and gales 13
— at Walpole Highway, Damage by 261
—. Ball 212
—, Trees damaged by 138
Line-squall at Split, Dalmatia ... 116
Line-squall, Nov. 2nd, 1930 ... 260
London area, Unusually red sunrises and sunsets in the ... 154
London fog 89
—, Statistical probability of rain in 131
—, Temperature in 135
Lyons. Col. Sir H. G. 147

Malay Archipelago, Sea-surface temperatures in the 49
Margary, I. D.
Marshall, R. } Phenological report, British Isles, 1929 ... 258
Marshall, W. A. L., Early weather record 89
—, From the meteorologists at Cardington 236
McAdie, A., Atmosphere as a colloid 66
McAnnally, H. W. W ... 121,271
McCurdy, N. R. 122

PAGE

Mediterranean forecasting, Importance of Atlantic ship observations for 18
Mémery, H. Recent heat and thunderstorms 211
Meteor, Great Siberian 88
Meteorograph, Dines balloon ... 37
Meteorological-aerological station at Cape Guardafui 269
— Committee, International ... 241
— Glossary 208
— Office, Annual Report 209
— —, Discussions at the 9,207,241, 257,284
— —, Shoeburyness staff dinner.. 51
— —, Soirée 51
— Society, Royal 9, 37, 63, 87, 112, 135,258,284
— — —, Buchan Prize 284
— — —, Symons Gold Medal ... 10
Meteorology, Ancient Hindu ... 263
— and water supply 64
—, Manual of, Vols. II and III 105
Mirage at sunrise, Inferior ... 138
Mirrlees, S. T. A., Annales de l'Observatoire National d' Athènes (review) 20
—, Climate of the Netherlands (review) 166
—, Hurricanes in the Fiji Islands 69
—, Isobaric distribution and weather in the Bay of Biscay (review) 193
—, Santo Domingo hurricane ... 216
—, and C. E. P. Brooks, Annual variation of temperature in London 135
— — —, Meteorological results of journeys in the southern Sahara 36
Mock-suns, Display of 114
Moe, Asche, North sea as link between climate . . . in the British Isles and in Norway... 259
Monsoon, European 73
Moon, A., Halo phenomena ... 287
Moorhead, H., " Flattish " hailstones in Cyprus 289
Mulholland, P. I., Illumination from sun and sky 257
—, Weather and crops (review)... 293
Muottas-Muraigl, Climate of ... 118

Nakamura, K. 99
Nansen, F. 120
Nephoscope observations, Significance of 280
Netherlands, Climate of the ... 166

PAGE

New Zealand, Thunderbolt in southern 38
Newnham, E. V., Temperature close to the ground on clear calm nights 59
—, Training for observers ... 216
Nile floods 98
Nimmo, E., Lightning and gales 13
Nokkentved, Chr. and J. O. V. Irminger, Wind pressure on buildings (review) 192
Normandy, Weather lore of ... 90
North Downs, Underground water level in the 187
Northeast Land, Glacial conditions and quaternary history of 119
Northumberland thundertsorm ... 212

OBITUARY :—
Algué, Father J. 147,170
Christmas, W. D. 295
Cox, Prof. H. J. 51
Eckardt, Dr. W. R. ... 147,218
Exner, Dr. F. M. 50
Giblett, M. A. 219,225,230
Nakamura, Dr. K. 99
Nansen, Dr. F. 120
Rogers, H. A. 270
Royds, Vice-Admiral Sir Charles 295
Ruser, Kommodore H. 147
Turner, Prof. H. H. 194
Observations in the Sahara ... 141
Observers, Course of training for 160,216
Official Notices 160,207,241
Official Publications 9,36,160,184, 208,242

Parhelia and halo 67
Parsons, F. J., Peculiar cloud phenomena 215
Pen reservoir with delayed ink feed 261
Pen, Rounded Baxendell 261
Pens. Delayed ink feed for crowquil 115
Percolation at Grayshott 40
Periodicities, Suggested annual recurrence of short 71
Peters, S. P., Upper air temperature in Iraq 242
Phenological report 258
Pick, W. H. and D. F. Bowering, Minimum temperatures on " radiation nights " 66
— and F. E. Coles, Waterspouts in British waters 38

PAGE
Pilot balloon " stations " on German liners 171
Pilot balloons, Upper air temperature indicator for use with ... 165
Pilot's report of landing through a sand devil 45
Phillpotts, G. S., Volcanic eruptions and pressure distribution 39
Polis, P. 147
Pressure distribution and volcanic eruptions 39

R 101, The loss of the 226
Radiation, Distribution of terrestrial 37
— nights, Minimum temperatures on 66
Rain gauges, Evaporation from... 161
— — for tropical use 81
— — in frosty weather 162
— in London, Statistical probability of 131
— in short periods, Heavy falls of 284
— of Nov. 11th, 1929, Heavy ... 32
Rainbows, Intersecting 213
—, Red 13
Rainfall for fifty years, Summary of Indian 21
— near Whitby, July 20th-23rd, 1930, Heavy 158
— of India, Annual 259
— of 1930 290
— over short periods in India, Heavy 269
— tables, 1930 ... ... *monthly*
—, 1930, General Distribution *monthly*
Rainfalls in short periods, Simple equation for heavy 70
Rawnsley, M., Peculiar cloud phenomena 287
REVIEWS :—
Annales de l'Observatoire National d'Athènes; S. T. A. Mirrlees 20
Anales del Observatorio Nacional de San Bartolomé en los Andes Colombianos 50
Berlage, H. P.—Sea - surface temperatures on some steamer routes in the Malay Archipelago; E. W. Barlow ... 49
Braak, C.—Climate of the Netherlands; S. T. A. Mirrlees 166

PAGE
Brooks, C. E. P.—Climate; C. B. Thurston 46
Chatterjee, C. — Upper air temperature indicator for use with pilot balloons 165
Data of heavy rainfall over short periods in India; J. Glasspoole 269
De Geer, G.—Geochronology ... 218
Deutsch. Meteor. Jahrb. Bayern, 1928; A. F. Crossley ... 292
Deutsch. Meteor. Jahrb., 1927, Freistaat Sachsen 146
Doporto, M.—Tipos de distribución isobárica y de tiempo en el Golfo de Vizcaya; S. T. A. Mirrlees 193
Dorno, C.—Klima von Muottas-Muraigl; L. D. Sawyer ... 118
Einführung in die Geophysik II; J. M. Stagg 97
Geiger, R.—Messung des Expositionsklimos, *Forstwiss. Centrabl. Berlin* 51 140
Gião, A.—Mécanique différentielle des Fronts et du Champ isallobarique; C. K. M. Douglas 167
Groissmayr, F. B.—Beitrag zur Langfrist Wettervorhersage: E. W. Bliss 74
—, Nilflut und der Temperaturcharakter des Folgewinters in Leipzig; E. W. Bliss ... 98
—, Nilflutstudien; E. W. Bliss 98
India Meteor. Dept. Scientific Notes, Vol. I, Nos. 4-6; E. W. Bliss 145
Irminger, J. O. V., and Chr. Nokkentved—Wind pressure on buildings 192
Mitteilungen des Volksgesundheitsamtes 166
Nokkentved, Chr. and J. O. V. Irminger—Wind pressure on buildings 192
Riel, P. M. van—Influence of sea disturbance on surface temperature; E. W. Barlow 20
Roediger, G.—Der europäische Monsun 73
Sandford, K. S.—Glacial conditions and quaternary history of Northeastland 119

PAGE
Shaw, Sir W. N.—Manual of Meteorology, Vols. II and III; C. E. P. Brooks ... 105
Summary of Indian rainfall for the fifty years 1875-1924; J. Glasspoole 21
Swinnerton, H. H.—Growth of the World and its inhabitants 72
Unakar, M. V.—Correlation between weather and crops; P. I. Mulholland 293
Veröffentlichungen des Forschungs-Institutes des Rhön-Rossitten-Gesellschaft Nr. 2 and 3 99
See also Official Publications.
Rhön-Rossitten Co., Publications of the research institutes of the 99
Rhythmic changes in air movement 92
Riel, P. M. van, Influence of sea disturbance on surface temperature (review) 20
Rodd, F. R., Meteorological results of journeys in the southern Sahara made by (review) ... 36
Roediger, G., European monsoon (review) 73
Rogers, H. A. 270
—, Rare cloud form 186
—, Red sunrises and sunsets ... 214
Royds, Sir C. 295
Ruser, H. 147
Russell, S. C., Halo phenomena... 137
—. Red sunrises and sunsets over the Atlantic and in the London area 154
—, Thunderstorm Aug. 29th-30th, 1930 185
—, Underground water level in the North Downs 187

Sahara, Meteorological results of journeys in the southern ... 36
—, Observations in the 141
Sand-devil, Pilot's report of landing through a 45
Sandford, K. S.. Glacial conditions in Northeastland ... 119
Sandiman, R. G. C., Low March temperatures 64
Santo Domingo hurricane ... 216
Sawyer, L. D. Klima von Muottas-Muraigl (review) 118
Saxony, Meteorological Yearbook, 1927 146
Schmidt, W.... 271

PAGE
Scotland, Aug. 29th, Thunderstorm in 184
Sea, Cold fogs over the 133
Sea disturbance on surface temperature, Influence of ... 20
Sea-surface temperatures 49
Selway, W., Pen reservoir with delayed ink feed. Rounded Baxendell pen 261
Sen, S. N., Ancient Hindu meteorology 263
Shaw, Sir W. N., Cyclones and anticyclones 209
—, Manual of Meteorology, Vols. II and III (review) ... 105
Siberian meteor 88
Simpson, G. C., Distribution of terrestrial radiation 37
—, Obituary of M. A. Giblett ... 225
Sky, Colouring of evening ... 14
Smith, N. H., June thunderstorms 129
Smoking sea 12
Snow and ice in America, Storm of 15
Somerville, J. J., Drawback of leeside exposures 254
Southport, Peculiar deposit at ... 144
Spence, M. T., Factors affecting visibility at Valentia 285
Split, Dalmatia, Sept. 21st, 1929, Line-squall and Bora at ... 116
Stagg, J. M., Introduction to Geophysics (review) 97
Starr, C. V., Evaporation from rain gauges 161
Stockholm, 1928, Illumination from sun and sky near ... 257
Storm of snow and ice in America 15
— on Victoria Nyanza 217
Street, Somerset, " Windrush " at 13
Sunrise, Inferior mirage at ... 138
Sunrises, Unusually red ... 154,214
Sunsets, Unusually red ... 154,214
Sunshine and cloud, Relation between 9
Sutcliffe, R. C., Atlantic ship observations and Mediterranean forecasting 18
Swinnerton, H. H.. Growth of the world and its inhabitants (review) 72

Temperature close to the ground on clear calm nights 59
— in Iraq, Upper air 242
— in London, Annual variation of 135

PAGE

Temperature indicator for use with pilot balloons 165
—, Influence of sea disturbance on surface 20
— observations in fog at Kew ... 277
Temperatures in the Malay Archipelago, Sea-surface 49
—, Instruments for obtaining dry and wet bulb 113
—, Low March 64
— on radiation nights, Minimum 66
Thermometer readings on board ship 184
Thermometers, Experiments with wet bulb 57,113
—, Wet bulb 95
Thomson, A., Abnormal vertical air currents 65
—, Thunderbolt in southern New Zealand 38
Thunderstorm, Aug. 29th-30th, 1930 185
— in Scotland, Aug. 29th ... 184
— near Ilkley on Apr. 25th, 1930 110
—, Northumberland 212
Thunderstorms and the recent heat 177,211
—, Electric field of overhead ... 87
—, June 129
— of Nov. 2nd, 1930 249
Thurston, C. B., Climate (review) 46
Training for Observers ... 160,216
Turner, H. H. 194

Unakar, M. V., Ancient Hindu meteorology 263
—, Weather and crops (review)... 293
Upper air temperature indicator... 165

Valentia, Visibility at 285
Venables, A., Thunderstorm in Scotland, Aug. 29th 184
Vertical air currents, Abnormal... 65
Viaut, M. André 195
Victoria Nyanza, Storm on ... 217
Vienna, Central Institute of Meteorology 271
Visibility at Valentia, Factors affecting 285
— in a fog, Range of ... 11,41,264
Volcanic eruptions and pressure distribution 39

PAGE

Wadsworth, J. 122
Walker, Sir G. T. 121
—, Seasonal forecasting ... 112
Walpole highway, Damage by lightning at 261
Washington, Carnegie Institution of 23
Water level in the North Downs, Underground 187
— supply and meteorology ... 64
Waterer, G. D., Halo phenomena 137
Waterspout at Cape d'Aguilar ... 287
Waterspouts in British waters... 38
Watson, R. A. 121
Weather and crops... 293
— cycles and weather recurrences 10
— diaries, Goodwood House, 1798-1806 70
— forecasting, Long range ... 74
— lore of Normandy 90
— map 160
— of a hundred years ago ... 262
— of the past winter—some comparisons 29
— of 1930 ... ... *monthly*
— record, Early 89
Webster, J. A. 271
Weller, H. J., Display of mock-suns 114
Wet bulb thermometers 95
— — —, Experiments with ...57,113
Whipple, F. J. W., Experiments with wet-bulb thermometers 57
—, Great Siberian meteor ... 88
—, Halos 93
Whitby, Heavy rainfall, July 20th-23rd, 1930 158
White, A. H., Trees damaged by lightning 138
Williamson, A. V., and K. G. T. Clark, Annual rainfall of India 259
Willis, K. G., Line-squall, Nov. 2nd, 1930... 260
" Willy-Nilly " in Crete ... 117
Wind force on board ship 184
— pressure on buildings 192
" Windrush " at Street, Somerset 13
World and its inhabitants, Growth of the 72

Zealley, P. R., Delayed ink feed for crowquill pens 115

ERRATA

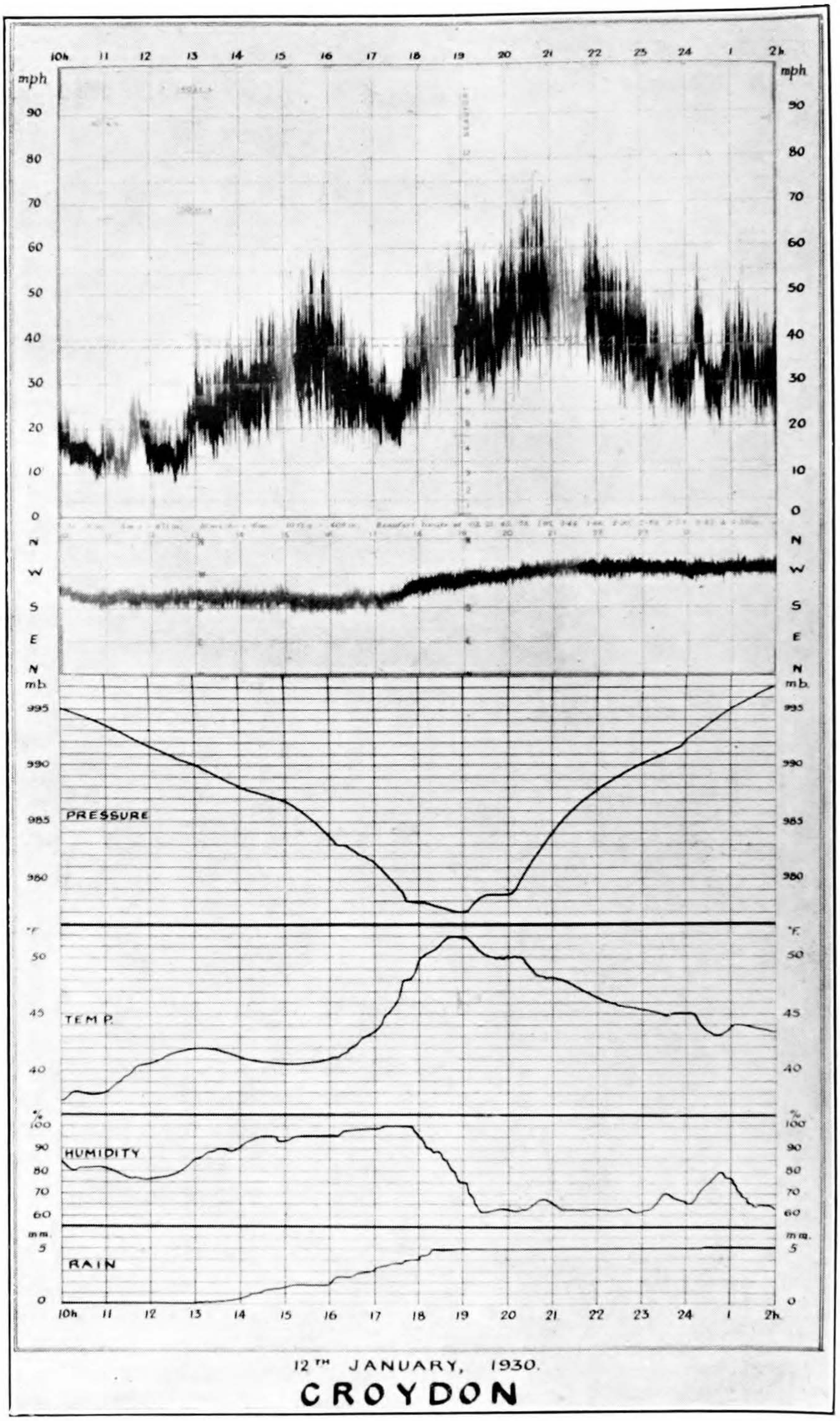
See pages 51, 88, 147, 171, 295.

CORRIGENDA

See pages 23, 195.

ILLUSTRATIONS

PAGE
Autographic records, Croydon, January 12th, 1930 ... ... *Frontispiece*
Synoptic chart, January 12th, 1930 5
Observation of the green ray at Aberdeen 7
Synoptic chart, October 26th, 1929 19
Pressure anomalies in two winters 31
Rainfall map of Rhondda Valley, November 11th, 1929 34
Fog map of London, January 21st, 1930 42
Abnormal vertical air currents 65
Synoptic chart, eastern Mediterranean, October 28th, 1929 ... 68
Wind records, Shoeburyness, January 17th-18th, 1930 ... *facing p.* 81
Flooding at Escroft, near Ilkley, April 25th, 1930 ... ... *facing p.* 105
Mock-suns 115
Cold front isochrones, September 20th-21st, 1929 117
Hailstones at Hinaidi, Iraq, April 24th, 1930 ... ... *facing p.* 129
Trees damaged by lightning, near Paris, July 24th, 1929 ... *facing p.* 129
Halo phenomena 137
Inferior mirage at sunrise 138
Downward air currents 139
Sahara temperature observations 143
Autographic records, Cardington, February 25th-26th, 1930 *facing p.* 153
Hair hygrograph record 163
Map of drought conditions in North America, August, 1930 ... 181
Forms of prismatic ice in a halo and circumzenithal arc ... 189
Diagram of room damaged by ball lightning 212
Intersecting rainbows 213
Peculiar cloud phenomena 215
M. A. Giblett, 1894-1930 ... ... *facing p.* 225
Scene of the Disaster to R 101, October 5th, 1930 228
Synoptic chart, November 2nd, 1930 250
Anemogram, Shoeburyness, November 2nd, 1930 253
Anemograph records, Hinaidi, January 6th, 1930 ... ... *facing p.* 254
Autographic records. Sealand, December 2nd, 1929 ... *facing p.* 255
Range of visibility in a fog 265
Nephoscope observations, October 2nd, 1930 282
Synoptic chart, October 2nd, 1930 283
Halo phenomena 288



Autographic Records.

M.O. 326.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 65
Feb. 1930
No. 769

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH; YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 15, DONEGALL SQUARE WEST, BELFAST; or through any Bookseller.

The Gale of January 12th, 1930

By F. H. Dight, B.Sc., A.Inst.P.

Recent issues of the *Meteorological Magazine* have contained several references to the stormy weather which characterised the three closing months of 1929, especially over the southern half of the British Isles. The account of the storm of Armistice Day* had hardly reached the printers before the greater part of the Kingdom was subjected to a further heavy buffetting by another severe gale on December 6th-7th. It was during this storm that the record wind gust velocity for Great Britain of 111 m.p.h. was recorded in the Scilly Isles. December, in fact, ultimately proved to be the stormiest month of the three, and there is little doubt that when the complete data come to be analysed, the period October to December, 1929, from the combined point of view of persistence and severity of the storms in the southern half of the British Isles will prove to be the stormiest period on record since the late 'nineties. Actually the period will need to include the first half of January, 1930, as it was not until Sunday, January 12th, that the climax of the stormy weather was reached. During the afternoon and evening of that day, the greater part of England and Wales, and to a lesser extent southern Ireland, were swept by a terrific gale. Inland, in parts of southern and southeastern England the wind reached speeds far in excess of those previously recorded by autographic instruments at inland stations. There was some loss of life, though

---

*See *Meteorological Magazine* 64. 1929, p. 249.

(88159) P.S. 14/89 1,050 2/30 M. & S. *Gp.303*

apparently rather less than in November, 1928, possibly because of the day and the time at which the gale reached the height of its fury. Considerable structural damage was reported; an enormous number of trees were felled, and telephone and telegraphic services disorganised. The greatest tragedy of the storm was the disaster which befell the Admiralty tug *St. Genny* which, hove to about 35 miles off Ushant, foundered at the height of the storm with the loss of 23 of her crew.

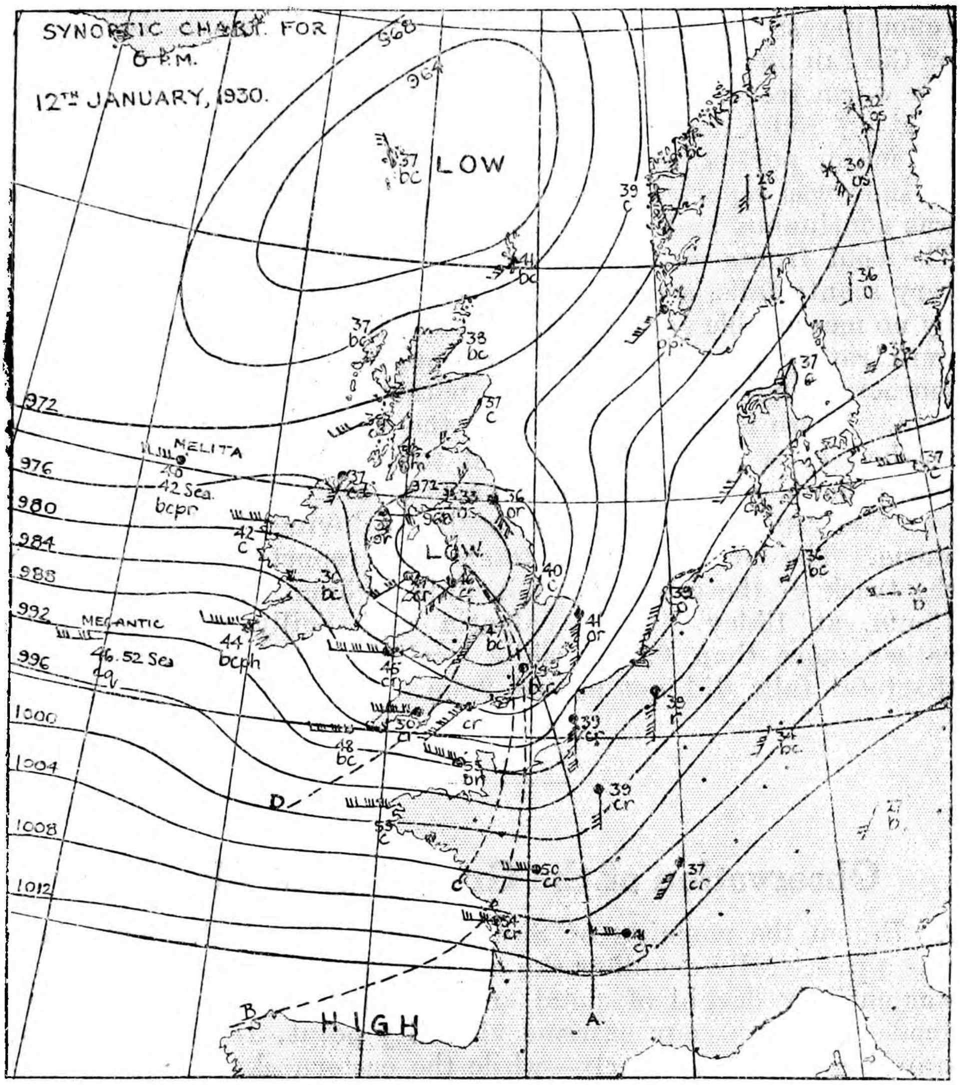
At 7 a.m. on Sunday, January 12th, a deep depression near the Faeroes, which had been responsible for a boisterous Saturday afternoon during which snow fell heavily for a time in many parts of England, was becoming less deep and pressure was rising generally with fair weather except in extreme southwestern Ireland. Although there were indications of a new disturbance well to northwest of the Azores at 1 a.m., there seemed no reason to connect this with a fall of the barometer at Valentia at 7 a.m., particularly as it was already raining there. It was not until later that the report from S.S. *Megantic* (Lat. 51° 12′ N. Long. 19° 54′ W.) giving a light southeast wind with a pressure of 974 mb., and adding the additional information that the barometer was falling more than 2 mb. per hour, suggested that a deepening secondary disturbance was rapidly approaching southwest Ireland. A conservative estimate shows that the average rate of travel of the centre between 1 a.m. and 7 a.m. could have been little less than the phenomenal speed of 80 m.p.h. During the next six hours it maintained an average speed of 75 m.p.h. and at 1 p.m. was centred over western Ireland, the pressure at Valentia, south of the " eye " of the storm, being as low as 971mb. The disturbance had not yet attained its maximum depth; at 6 p.m. the centre was over the Lake District, having travelled 350 miles in an eastnortheast direction in the intervening five hours, while the pressure had fallen to less than 966 mb. Thereafter, although maintaining its direction of motion, the average speed fell away considerably, and between 6 p.m. on the 12th and 1 a.m. on the 13th dropped to 44 m.p.h. When at 7 a.m. the centre was located over Denmark the pressure at the centre had risen to 980 mb. The total fall of pressure in southern England associated with the depression averaged 18 mb. and the approximate duration of the fall, in the southeast, 8 hours. The largest fall of pressure in 3 hours shown by the reporting stations was one of 13 mb. at Sealand (Chester) between 1 p.m. and 4 p.m. The rise which set in at the height of the storm was much more pronounced; at Valentia pressure rose 11 mb. in the first hour, and at Kew and various places in southeast England the rate was 6 mb. in the first hour.

With the approach of the disturbance the light southwest winds in southwest Ireland backed to south and freshened rapidly, gale force being reached at Valentia at 11 a.m.; gale force was reached at Scilly about the same time. It was not until after 10 a.m. that the winds over England and Wales started to back, but thereafter the sequence of events moved rapidly. At 1 p.m. a southwesterly gale was raging from southern Ireland to Brittany and the northern half of the Bay of Biscay, and, as later information showed, had already become a strong gale (force 9 Beaufort) over the open sea. Three hours later force 7 Beaufort was reported generally over southeast England, and the wind was still slowly increasing. As will be seen later the structure of the depression was complex, and it was with the last of three " cold fronts " that the fury of the gale was associated. This struck Valentia in a violent squall at 2.50 p.m.; the wind veered to NW. and increased quickly to a strong gale, reaching 77 m.p.h. in a gust. A whole gale from the west (force 10 Beaufort) was blowing off our southwest coast and the coast of South Wales by 6 p.m., and the full force of the storm was beginning to be felt in Wales and western England. During the next two or three hours the wind increased over the Midlands and eastern England, London experiencing the height of the gale between 8.30 and 9 p.m. The strongest winds lasted for about an hour, after which the speed fell away moderately quickly. The highest hourly wind speeds recorded were:—Scilly 65 m.p.h. with a gust of 97 m.p.h., Falmouth (Pendennis) 63 m.p.h., gust 102 m.p.h., Shoeburyness and Croydon 51 m.p.h. with gusts of 83 m.p.h. and 77 m.p.h. respectively. The gust velocity of 83 m.p.h. at Shoeburyness at 10 p.m. was a record for the station. Other violent gusts were 83 m.p.h. at Cardington (at 150 feet above the ground), 83 m.p.h. at Worthy Down, Winchester (a station record), and 75 m.p.h. at Plymouth and Spurn Head. The most remarkable figures, however, were obtained at Larkhill, where the mean hourly wind speed rose to 70 m.p.h. at 8 p.m., with a gust of 94 m.p.h. Not only was this the highest hourly wind reported for the storm, but in view of the inland situation represents an exceptional velocity, which most probably constitutes a record for a station in the British Isles so far from the coast. The highest mean speed recorded at Meteorological Office stations in the British Isles is 78 m.p.h. recorded at Fleetwood on December 22nd, 1894. It is hardly surprising, therefore, that the reports of damage to trees, buildings and livestock in parts of Wiltshire provide the most melancholy tale of destruction the writer has yet seen. A reliable authority asserted that in the immediate vicinity of the small market town of Devizes " something like 500 trees were swept down in that hour's fury of the elements on that Sunday evening." Mr. R. G. C. Sandeman, writing from Dan y Park, Crickhowell, south Wales, says: " From 4 p.m. to 7.35 p.m. it blew a whole gale with gusts of 65-70 m.p.h.* At 7.35 p.m. there was a terrific gust of 80 m.p.h. which blew down eight elm trees in our park. This is the highest velocity I have ever recorded here. The glass rose from 28·60 in. (968·5 mb.) to 28·80 in. (975·3 mb.) just after this gust and the wind moderated. The storm has done extensive damage to our woods and some of them look as if they had been shelled, the trees being snapped off like carrots . . . . ." Southeast England has probably not suffered such extensive damage since the great blizzard of March, 1916, when a heavy fall of snow added to the destruction caused by the gale.

An examination of the autographic records from selected stations revealed the complex structure of the southern section of the depression. The records obtained at Croydon have been reproduced as showing the essential features of the sequence of events typical in southern England, and should be examined in conjunction with the synoptic chart for 6 p.m., also reproduced. At that time the storm was already at its worst in the west. The barogram traces, with one exception, are remarkably similar. They show a very steady fall of pressure in front of the depression with a slight but definite check as the warm front passed. The minimum occurred some time later. The depression had a distinct and rather extensive warm sector at 1 p.m., for the warm front had then reached Falmouth, while a ship 160 miles further west reported continuous moderate fog. By 6 p.m., however, the warm sector had been reduced to a comparatively narrow belt at the surface. The warm front, reaching Valentia at 11.15 a.m., and Scilly rather earlier was marked by a sharp veer of the wind and an increase in the rate of rise in temperature. It advanced eastnortheast, reaching Holyhead and Larkhill at 3 p.m., Croydon at 4.10 p.m., and Felixstowe soon after 7 p.m. In eastern districts the wind veer was not so sharp, although temperature showed a decided rise with the entry of the warm air. The position of the warm front at 6 p.m. is indicated on the chart by the full line A; the broken lines B, C and D represent the first, second and third cold fronts respectively. The three cold fronts can be traced across from Valentia to Croydon. At the first-named station their passage is most marked on the thermogram where the first at 12.10 p.m. abruptly checked the temperature rise, while the second and third at 1.10 p.m. and 2.45 p.m. both resulted in sharp drops in temperature; the first two were also accompanied by slight veers of the wind, while the third, which heralded the height of the gale, veered the wind from WSW. to NW., and caused the rapid rise in pressure to which reference has already been made. At Croydon the first cold front at 5.45 p.m. brought a marked partial clearing of the sky, and effectively stopped the downward trend of the barometer. The effect on the temperature was less decisive, and although temperature ceased to rise for a time, a further definite rise occurred soon afterwards. It was in the sector between the first and second cold fronts that temperature reached its highest point for the day, often well above 50°F. The second cold front, which passed Croydon at 7.10 p.m., had only a slight effect on the pressure curve;

---

*Negretti & Zambra Dial type recorder; 16 feet above the roof, 54 fee above ground.


SYNOPTIC CHART FOR 6 P.M.
12TH JANUARY, 1930.
LOW
LOW
HIGH
968
964
972
976
980
984
988
992
996
1000
1004
1008
1012
MELITA
MEGANTIC
A
B
D

the wind veer was very slight and there was little increase in speed, but temperature fell away sharply. This sequence was typical of all the records examined in Southern England. In the later stages the first cold front showed little inclination to overtake the warm front. The final and all-important front was accompanied by a marked increase in wind force, a definite, but not sudden, veer in direction, a very rapid rise in pressure, and a further sharp fall in temperature. It reached Pendennis at 4.10 p.m., Holyhead 6.30 p.m., Larkhill 7 p.m., and Worthy Down half an hour later. It struck London at 8.15 p.m. and Felixstowe at about 10 p.m., and in every case the full fury of the gale was experienced from the west in the hour subsequent to the passage of the cold front.

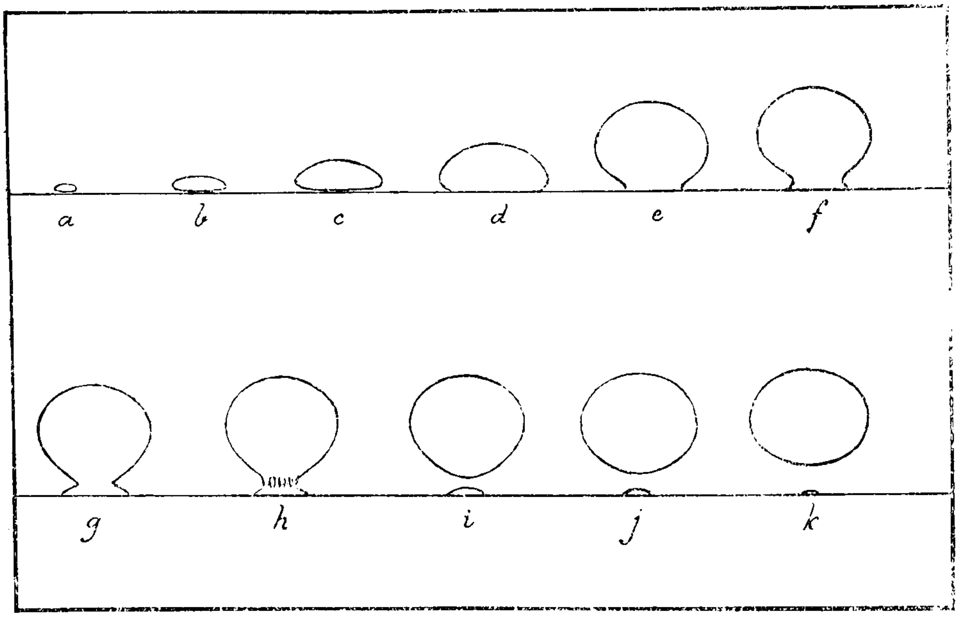
Another interesting feature of the storm was the comparatively small amounts of rain reported, at any rate at the lower level reporting stations. Rain set in very soon after the beginning of the fall in pressure, the rain area extending far in front of the warm front. At 13h. the rain belt had a maximum width of about 250 miles and it was raining generally over Wales and the major portion of the Midlands and southern England. Sleet or snow was reported locally at first in the Midlands. The rain was continuous and steady until the arrival of the warm front. The cold fronts were, however, associated in many parts with very scanty falls, sometimes by only a slight shower, and locally by no measurable rain at all, although in some places the showers were rather heavier. Even the main cold front passed over southern England at any rate without giving any noticeable rain. There is some evidence in the west that its passage was marked by a heavy shower, and some press reports indicated that some flooding resulted in parts of south Wales. Lightning was also reported from a few localities during the height of the storm. The largest rainfall totals were reported from places in the track of the centre, and include 14·5mm. at Holyhead and 13mm. at Ilkley. Both Valentia and Scilly measured only rather more than 6mm., while locally on the south-east coast the total falls did not exceed 2mm.

Observation of the Green Ray at Aberdeen

At 7h. on the morning of Sunday, November 3rd, 1929, there was a practically cloudless sky at Aberdeen. The eastern horizon was entirely devoid of cloud and the visibility was remarkably good—objects at our extreme visibility point, 18 miles distant, standing out very clearly—while the eastern sky showed a belt of deep orange colour, shading gradually into the clear green-blue above it. The exceptional degree of visibility indicated that the strong orange coloration owed nothing to selective absorption by local atmospheric pollution; it must therefore have been due to the presence of fine particles in the higher layers of the atmosphere generally.

The conditions were therefore deemed very favourable for observing the phenomenon of the " Green Ray," and a telescope of 3 inches clear aperture, fitted with a terrestrial eyepiece, was directed to the point where the sun should first appear above the horizon.

The expectation was amply justified, for the first appearance of the sun was a small flattened button-shaped spot—*a* in the figure—of intense green light which was followed almost immediately by strong yellow as the segment of light took definite shape (*b* in figure). During the time that the sun continued rising through the successive stages *c* to *i*, its upper limb remained fringed with a definite though gradually narrowing edge of green, which was still faintly discernible even at the *k* stage. The changes of form through which the sun's disc passed are shown in the figure; in the first stages *a*, *b* and *c* the lower edge seemed to be separated very slightly from the sea-horizon; at *d* it appeared to be in contact therewith, while in the succeeding stages the disc seemed to be joined to the horizon-line by a connecting strip whose appearance altered as shown in stages *e* to *h*. This connecting strip appeared to be due to some " mirage " effect, for, at the instant of separation from the sun's disc—stage *h*—the last connexions took the form of flickering orange-red flames in rapid vertical motion between disc and reflection. Separation was complete at stage *i*, when the sun's disc had an ovoid form, flattened at the top, but extended and much pointed below, the lower edge being orange-red while the upper edge was still narrowly green. The final disappearance of the lower reflected segment of light occurred at stage *k*, when the sun's lower limb was about a



quarter of a degree above the horizon, and at that time the disc had assumed its normal ellipsoidal form, with a vertical axis between 80 and 85 per cent. of the length of the horizontal one.

This telescopic observation, having been made at sunrise, confirms the theory that the green ray is a truly optical effect, due to the refraction of the sun's rays by the atmosphere, and that it is not merely an effect due to the physiological reactions of the retina, as has been suggested when the ray has been observed at the time of sunset. The persistence of the green fringe on the upper limb until after the complete disc was visible above the horizon disposes finally of the latter explanation, as does equally the presence of a reddish fringe on the lower limb.

The observation lasted six or seven minutes, and during the whole time no difficulty was experienced in observing the sun's disc directly through the telescope without in any way screening or reducing the light. The absorption of light by the atmosphere, despite the extreme visibility, must therefore have been very considerable. The dark spotted areas on the sun's disc were plainly visible, and so also were the surrounding facular areas, which appeared definitely brighter than the rest of the disc.

There is one further point worthy of remark—a physiological one. The sun was observed throughout with my right eye, the left one remaining closed. After the observation, when I viewed the general landscape with my right eye only, the whole field of view was darkened and suffused with a strong magenta-violet tint, as compared with its normal appearance to the left eye. This effect gradually disappeared, but endured for fully five minutes before both eyes gave the same normal view. This would suggest that the retina of my right eye had become fatigued and temporarily insensitive to the yellow-green light rays, to which magenta-violet is the complementary colour.

G. A. CLARKE.

It is interesting to compare Mr. Starr's friends' experience of the green flash as described in the January issue of the *Meteorological Magazine* with that of a Mr. E. M. Dence, who wrote to *The Times* (August 19th, 1929) as follows:—

"My wife was with me and as we had protected our eyes up to the last few seconds we were both able to agree that the transformation to green was unmistakable."

It will be noted that Mr. and Mrs. Dence took practically the same precautions as the observers at Jaffa, but with a different result.

CICELY M. BOTLEY.

Guildables, 17, *Holmesdale Gardens, Hastings. January* 23*rd,* 1930.

OFFICIAL PUBLICATIONS

The following publication has recently been issued.

PROFESSIONAL NOTES.

No. 53. *The Relation between the Duration of Bright Sunshine registered by a Campbell-Stokes Sunshine Recorder and the Estimated Amount of Cloud.* By C. E. P. Brooks, D.Sc. (M.O. 273m.)

The paper assumes that when the sun is below a certain level it will fail to burn the card in a Campbell-Stokes recorder. On the other hand, some visible cloud is too thin to prevent the sun from burning the card, and the further assumption is made that this thin cloud is high cirriform cloud and that the amount visible is proportional to $c(1 - c)$ where c is the proportion of the sky covered by cloud. The relation between duration of sunshine s, expressed as a fraction of time between sunrise and sunset, time w during which sun is below 5°, expressed as a similar fraction, and cloudiness c can therefore be written:

$$s/(1 - c) = (1 + tc)(1 - aw)$$

where t and a are constants. From monthly normals of sunshine and cloudiness during the same years at a number of stations, the values of the constants t and a are determined; t is found to be equal to 0·6, and is independent of latitude, while a varies from about 1 at inland places in high latitudes to 2 in middle latitudes. At mountain and some desert stations a is very small, showing that the sun burns the card when just above the horizon; in great cities it is very large, 3·5 at Greenwich, showing that owing to the smoky atmosphere the sun does not burn the card until it is on the average 17° above the horizon.

Monthly sunshine averages calculated from mean cloudiness by this formula agree well with the observed amounts, the average error at Valentia being less than two per cent.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings will be :—

February 24th.—*On the relation between the rotation of the sun and variations in atmospheric temperatures.* By K. F. Wasserfall. (Oslo, Norske Videnskaps-Akademi, Geofys. Pub. 5, No. 10. 1929.) *Opener*—Mr. D. W. Johnston, B.Sc.

March 10th.—Dr. G. C. Simpson, C.B., F.R.S., will explain the programme, which has been proposed by the International Meteorological Committee which met in Copenhagen in 1929, for a second Polar Year in 1932-3.

Royal Meteorological Society

The Annual General Meeting of the Society was held on Wednesday, January 15th, at 49, Cromwell Road, Sir Richard Gregory, D.Sc., President, in the Chair.

The Symons Gold Medal, which is awarded biennially for distinguished work in connexion with meteorological science, was presented to Dr. G. C. Simpson, C.B., F.R.S., Director of the Meteorological Office, Air Ministry, and the Council of the Society for the ensuing year was duly elected, the new President being Mr. R. G. K. Lempfert, C.B.E., M.A., F.Inst.P.

Sir Richard Gregory addressed the Fellows on "Weather Cycles and Weather Recurrences."

When Joseph interpreted Pharaoh's dream of seven fat kine and seven lean kine as signifying seven years of plenty and seven of famine, his prediction was probably based upon a weather cycle or period of about fourteen years. Though the periodicity could not have been very highly developed it was sufficiently well marked to influence the general character of the seasons. The predictions made by Elijah and Elisha may have been founded upon knowledge of this kind of general periodicity preserved by the priests.

The extraordinary weather of the year 1929— frosts, droughts, floods and gales—gives renewed interest to the question whether these abnormal phenomena return in regular cycles or whether their occurrence is irregular. Innumerable weather cycles have been described, of which the best known are the Brückner cycle of about 35 years and the sunspot cycle of eleven years. The Brückner cycle is an alternation of groups of years which are on the whole cool and wet with groups of years which are on the whole warm and dry; it is useless for forecasting the weather of individual years. It may, however, be important in business affairs, where profits may accumulate during long runs of generally favourable years, to be dissipated when conditions become generally unfavourable. In the rainfall of the British Isles a fifty-year cycle is far more evident than the Brückner cycle, and gave us, for example, wet periods in the 1870's and the 1920's. The eleven year sunspot cycle is important in tropical regions, and is strictly reflected in variations of the level of Lake Victoria, but is almost non-existent in the weather of the British Isles.

From time to time shorter cycles appear in our weather. Between 1868 and 1886 every fifth year was outstandingly wet; from 1887 to 1909 every third year was wet; while from 1910 to 1922 the odd years were all dry and the even years wet. Each of these cycles while it lasted, was astonishingly regular, but each broke down just when it seemed to be definitely established, and such cycles are useless for forecasting.

There are other weather cycles, especially in rainfall, having a length from five or six days to a month. A possible seven-day cycle has been discovered in the manufacturing town of Rochdale, where the rainfall on Sunday, when the air is comparatively clean, is on the average less than that on the other days of the week, when the air is smoky from the factory chimneys. A more general cycle of five or six days probably exists over the greater part of the northern hemisphere, but these short cycles are too indefinite and irregular to be of service in forecasting, and attempts to employ them for predictions several weeks in advance have not met with any appreciable success.

The best known examples of weather recurrences are Buchan's warm and cold spells, supposed to return at about the same dates each year. These were discovered from observations in Scotland in the middle of the nineteenth century, and there is no warrant for expecting to find the same recurrences in the weather of southeast England in the twentieth century. The general conclusion is that neither weather cycles nor weather recurrences are at present of any value in forecasting coming weather for any particular year, month or day.

Correspondence

To the Editor, *The Meteorological Magazine.*

Range of Visibility in a Fog

The fog this morning at Golders Green was very dense; the visibility about 10 a.m. was between 15 and 20 yards. Half an hour later in Kingsway I observed the visibility to be between 150 and 200 yards. That contrast is in itself interesting, but the purpose of my letter is not primarily to draw attention to this. By a piece of good fortune I was able to make an observation of the difference between ordinary visibility and the visibility of a light in a thick fog, and the result was to me, at any rate, sufficiently surprising to make me want to tell it in the hope that others might be able to contribute from their experience similar observations under varying conditions.

Although the fog was thick the light was moderately good, *i.e.*, the light was not bad enough for the street lamps to be lit. One lamp, however, about 200 yards north of the entrance to Golders Green station on the Finchley Road, was being cleaned by a workman who had lit it. The distance at which I could distinguish the lamp-post and the workman (who was at the top of a ladder and at about the same level as the light) was between 15 and 20 yards; but I could see the light between 10 and 15 yards further away. I ought to mention that the lamp was an incandescent gas lamp and that both the lamp and the workman would have had a "sky" background, if the fog had not been so thick that no "sky" could be distinguished.

I had anticipated that in a very dense fog the difference between the distance of visibility of a light and the distance of visibility of an ordinary object would not be more than 2 or

3 yards. It appears, however, from this observation that the light is visible at a distance greater by more than 50 per cent. I observed a similar difference between the distance of visibility of a red light at the top of an automatic ticket machine at the entrance to the station and the distance of visibility of the machine itself.

In Kingsway the lamps were alight; the lamp standards in the centre of the road I could distinguish at a distance rather greater than twice the distance between them; but I could see the light of the second standard beyond the last standard directly visible, *i.e.*, about 150 yards further away. The outline of Bush House, on the other hand, could be seen about as far away as the furthest light visible, although the details of the building itself could not be distinguished at all at that distance. The sun was visible at Kingsway though not at Golders Green.

E. GOLD.

January 21*st*, 1930.

Smoking Sea

The phenomenon described by Mr. T. H. Applegate in the December number of the *Meteorological Magazine* can be observed in winter even in very temperate climates. In the Cloud Photography Exhibition held last June at Barcelona by the International Cloud Commission, this fact could be seen reproduced in a very striking manner in some copies obtained by our assistant, Mr. J. Pons and belonging to the archives of the "Fundacio C. Rabell."

Close to the coasts of Catalonia, and more particularly before the creeks of the "Costa Brava," between Blanes and Port-Bou, smoking sea appears at sunrise on the calm days of December and January, when the Iberic anticyclone is predominant. In such circumstances, the cold "terrals" or landwinds, produced by the strong irradiation which has prevailed during a cloudless night, come in contact with the warm Mediterranean stream which runs along our coast from south towards the north; the difference of temperature between the air and water masses reaches easily 22° or 25° F., and the mouth of every one of these slow air currents is then marked by a field of characteristic condensations.

These condensations do not mix in a continuous fog, as the sun, which rises splendid in such days, soon makes an end of the "terral." Their forms are rather discontinuous, and it is not rare to see them as a multitude of "fog-flames" of very short duration but several meters high.

E. FONTSERÉ.

Servicio Meteorologico de Cataluna, Barcelona. *January* 4*th*, 1930.

Lightning and Gales

The record-breaking gale of the night of December 6th-7th was very remarkable in that it was accompanied by lightning for several hours. I have often observed a flash or two at the passage of the trough of a depression, or during squally showers in its rear, but never anything like this before in winter.

This depression was not preceded by the usual cirrus, cirro-stratus, alto-stratus succession; the morning was showery, with cumulo-nimbus, and at 1 p.m. a large area of dark cloud moved up from the southwest; in the distance I thought it was merely another anvil-type cumulo-nimbus, such as we had been having during the morning, but it advanced much more slowly, and eventually resolved itself into an area of alto-stratus with fracto-stratus beneath, but it showed a much more sudden transition from blue sky to heavy cloud than is usual in an advancing depression. At 4 p.m. rain commenced and was pretty heavy and steady till 7.30 p.m. when 0·32in. had fallen. After this the rain was not at all heavy, only 0·29in. falling all the rest of the night, but the lightning persisted in the most extraordinary way—I saw the first flash about 7 p.m. and the last about 1.30 a.m., and between 9 p.m. and 12.30 p.m. I counted nearly 100 flashes, which is far more than I have ever seen before in the winter, and all the time an exceptionally strong gale was raging. The barometer was very low for the south of England and falling slowly all the time. I do not know if you have experienced anything similar but this combination of a great gale with persistent lightning is new to me.

Another remarkable though less impressive, feature of the weather lately is that for 22 successive days the maximum here has been 50° or over. E. NIMMO.

Chinley, Grange Road, Broadstone, Dorset. December 10th, 1929.

"Windrush" at Street, Somerset

Mr. J. Edmund Clark informs us that at 6.20 p.m. on December 6th, 1929, four big elms along Portway, Street, Somerset, crashed all together within 50 yards as well as the largest local pear tree, 40 feet high. This was part of a "windrush" three miles long from southsouthwest to northnortheast, which was parallel with another four miles distant. The barometric trace showed a remarkable instantaneous rise and fall of ·007 in. (0·2 mb.) during a pause of 1½ hours halfway down a rapid fall to 28·38 ins. (961 mb.).

Red Rainbow

On November 7th, 1929, a halo was observed between 7.0 and 7.10 G.M.T. from a point 5 miles south of this station. The halo appeared in the cirro-nebula clouds which covered the sky at the time, and took the form of a red bow at a vertical angle of about 45°, the centre bearing northwest from the point of observation. The bow was similar in position to the rainbow which has been seen on previous occasions at this time. The sky in the east was observed to be very red at the time; the sun had not then risen. As the light grew stronger the bow gradually disappeared, fading first at the centre.

E. W. Blair.

Royal Naval Cordite Factory, Holton Heath, Wareham. December 8th, 1929.

Colouring of Evening Sky

I have observed on two occasions a sky phenomenon similar to that described by Mr. Southcombe in the December magazine. Both occasions were at sunrise. On November 5th, 1926, the sky was uniformly covered with nimbus and heavy rain was falling, when the whole sky became suffused with a pink tint. Thhe phenomenon was repeated on January 21st, 1928. This time the range of visibility was not more than 100 yards and light drizzle was falling. In both cases the pink colour was of the same intensity in all parts of the sky.

S. E. Ashmore.

Windwhistle Cottage, Grayshott, Hindhead, Surrey. December 27th, 1929.

I have frequently observed the red colour that sometimes comes over a clouded sky at sunset. I have always considered it to be due to a layer of high cloud becoming a brilliant red under the setting sun; when this happens in the absence of low cloud everything is suffused with a red glow. When the sky is overccast with low clouds all the light that reaches the ground (or what is the same thing, the under surface of the low clouds) at sunset, or just after, is the light from the sky above; if this is predominantly red the effect will be exactly that described by Mr. H. W. Southcombe in the December number of the *Meteorological Magazine.* I think the effect may often be seen if carefully looked for, and just occasionally it is very marked. The conditions would seem to be a layer of low cloud, detached masses of high cloud, either cirro-cumulus or high alto-cumulus, and a clear sky to the west above the layer of low cloud.

C. J. P. Cave.

Stoner Hill, Petersfield. January 22nd, 1930.

Unusual Audibility

With reference to the article "Unusual Audibility," appearing in the August *Meteorological Magazine*, may I be allowed to make a few comments.

I am convinced that, given the most ideal conditions it is extremely doubtful whether the bursting of such a balloon could be heard at even 5,000ft., and as far as I am able to ascertain one has not previously been heard above 1,000ft. Having had nearly ten years' experience in making pilot-balloon ascents during which there have necessarily been a number of bursts at various levels I must admit that the noise has entirely escaped me. Mr. Baxter mentions that a 12 m.p.h. wind was blowing at the time, which would not have made the conditions ideal for hearing such a faint sound, and yet he says the noise was quite distinct. I am wondering whether Mr. Baxter has witnessed and heard anti-aircraft shells bursting at those high levels (14,000 and 17,000ft.), or whether he has himself flown at those heights in order to appreciate what 3-4 miles above the ground means.

I am convinced that what Mr. Baxter heard was a distant gunshot or some such noise, and that to hear the bursting of a small balloon at such heights is utterly impossible.

J. G. GOODYEAR.

R.A.F. Station, Upper Heyford, Oxon. August 23rd, 1929.

NOTES AND QUERIES

A Storm of Snow and Ice in America

From December 17th to 20th, 1929, the north-eastern parts of the United States, and especially Maine, were visited by one of the worst storms of snow and ice on record there. The storm is of interest, not only for the material damage and the remarkable character of the weather, but for the abnormal barometric distribution which caused the phenomena.

On the morning of December 16th an anticyclone lay over southern Canada, and this persisted until late on the 19th. It was very intense; at 8 a.m. on the 17th pressure was 1047 mb. at Prince Albert, Saskatchewan, and at 8 a.m. on the 18th 1052 mb. over North Dakota. On the 17th the northerly winds associated with it brought snow over Maine. On the southern flank of this anticyclone a depression traversed the United States, growing in intensity. On the 16th it travelled south-eastwards from Idaho to a position northeast of the Gulf of Mexico. On the 17th it continued eastwards, and at 8 a.m. on the 18th it was centred over Tennessee. Over the eastern United States there were accordingly two great wind systems; in the north a cold northeasterly current blowing on the southeastern margin of the anticyclone, and in the south a warm southerly current on the eastern side of the depression. These two winds met over the northeastern States, where in a distance of less than 100 miles from north to south temperature rose by 30°F.

The southerly current brought fog, mist and rain, and must have been saturated with moisture. Though no direct evidence is available, there can be no doubt that where it met the northeasterly winds it rose and continued northwards at a height of a few thousand feet. The rising air produced heavy rain, which became super-cooled as it fell through the lower layer of air from northeast, at a temperature of 20° to 30°, and froze whenever it touched a solid object.

On the morning of the 19th the depression was centred over Pennsylvania and these conditions were accentuated, temperature rising 40° in 100 miles. Southeast of the depression were southerly winds with rain and fog, northeast of the centre northerly winds with super-cooled rain, and still further northeast, on the margin of the anticyclone, northeasterly winds with snow. To the west of the depression a northerly blizzard was blowing over the central States.

On the 20th the centre of the depression crossed Maine. The southerly winds extended to the coast at Portland, temperature rose rapidly well above the freezing point, and the ice-storm was over. Then in the evening the cold northwesterly winds in the rear of the centre spread eastwards, and there was a sharp frost; as the *Lewiston Evening Journal* expressed it: " temperatures again hit the toboggan." At Auburn the maximum temperatures were 22°F. on December 17th, 30° on December 18th (at midnight, after being 24° all the afternoon), 32° on December 19th. On the 20th the thermometer rose rapidly to 38° at noon, with the onset of southerly winds, and fell again as quickly in the evening.

The total precipitation was 2·15 inches of water; this included 6¼ inches of snow, equivalent to 0·6 inch of rain, the remaining 1½ inches falling as super-cooled rain.

Mr. Earl C. Austin has kindly sent us copies of two American papers, as well as a long letter descriptive of the storm, and the following particulars have been extracted from these sources. The storm area covered most of the United States from the Rocky Mountains to the Atlantic coast and from Canada to the Gulf of Mexico, but was especially severe in the northeast, for which the experiences at Auburn and Portland, Maine, are typical. At Auburn it began on the 17th as a mild snowstorm, which became heavier as the evening came on. About 10 p.m. the snow turned to super-cooled rain, which in America is known as sleet. This froze on every object it touched, giving the result known in this country as glazed frost. This freezing rain continued throughout the night of the 17th and nearly the whole of the 18th. By the morning of the 19th everything, houses, trees, wires, poles, were sheets of ice, trees and wires being nearly at breaking point. The 19th was cloudy and overcast with thick mist and drizzle but in the evening this again turned to heavy freezing rain which fell with a strong wind. The electric wires broke under the weight of ice, light and power failed, and the cities were in darkness. On the morning of the 20th rain fell in torrents; trees, wires and poles were falling all over Auburn and Lewiston. That night the cities were pitch dark and completely isolated. On the ground in the streets were 5 or 6 inches of snow, covered by a crust of ice an inch thick, the whole littered with branches of trees. In Portland conditions were even worse, the fine old elms, oaks and other shade trees in the famous avenues looking as if they had been shelled by artillery. On the morning of the 20th with the near approach of the centre of the depression, there were thunderstorms in many parts of New England, the sound of the thunder mingling with the crash of breaking trees; at Springfield, Mass., a house was struck by lightning. No street cars ran for two days, the schools were closed and there were many accidents, several people being killed by skidding motor cars. The damage was estimated at millions of dollars, and the storm was in general the most severe for half a century.

Frequency of Fogs of Different Depths

The inversion which exists above a fog gives a rough indication of the height of the surface of the fog if the temperature gradient is known. At Leafield, Oxfordshire, continuous records of temperature gradient are kept by means of recording thermometers at 4ft., 40ft., 100ft., 185ft., and 285ft. In the following frequency table the approximate height of the base of the large inversion is given for every occasion on which fog was observed (visibility less than 1,000yds.) during the year July, 1928, to June, 1929.

Height.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June
feet.												
>> 300	...	...	1	2	1	...	...	1	3	...	...	1
> 300	...	...	5	...	3	5	6	...	1	...	...	1
200-300	...	...	2	...	1	3	3	...	1	...	...	...
100-200	...	...	1	1	1	1	2	2	2	1	1	...
40-100	...	...	...	...	...	1	...	...	...	...	...	...
< 40	...	...	...	1	...	1	...	1	2	...	...	...
Intermittent ground fogs	...	...	...	...	1	...	1	1	...	...	...	...
All heights	...	...	9	4	7	11	12	5	9	1	1	2

Very often, when the fog was of great vertical thickness, there was a perfectly steady lapse up to 300ft., similar to the temperature gradient observed when the sky is heavily overcast; these fogs are entered in the table as having the inversion much greater than 300ft. up. On other occasions no marked inversion was recorded, but the lapse rate was unsteady, indicating that the fog did not extend very much higher than 300ft; these have been entered as having the inversion slightly more than 300ft. up. If we take it that the top of the fog is at the level of the base of the inversion (and eye observations of the depth of shallow ground fogs support this suggestion), the entries in the left-hand column give the height of the top of the fog. When the level of the inversion was changing during the fog, as it frequently did, the height given is that during the middle of the foggy period.

Of the 61 fogs observed, 31 were ground fogs (upper surface below 300ft.). The annual distribution of frequencies is much the same for ground fogs and deep fogs, with a maximum in midwinter, and secondary maxima in September and March. The scarcity of fogs in the summer months is a little misleading; probably a few ground fogs occurred at dawn and passed unnoticed, as no observer is on duty between 18h. 30m. and 6h. 30m. When blue sky or higher clouds could be seen in the zenith, the fog was in no case deeper than 300ft.

Leafield, owing to its position on the top of a ridge, suffers from three more or less distinct types of fog:—

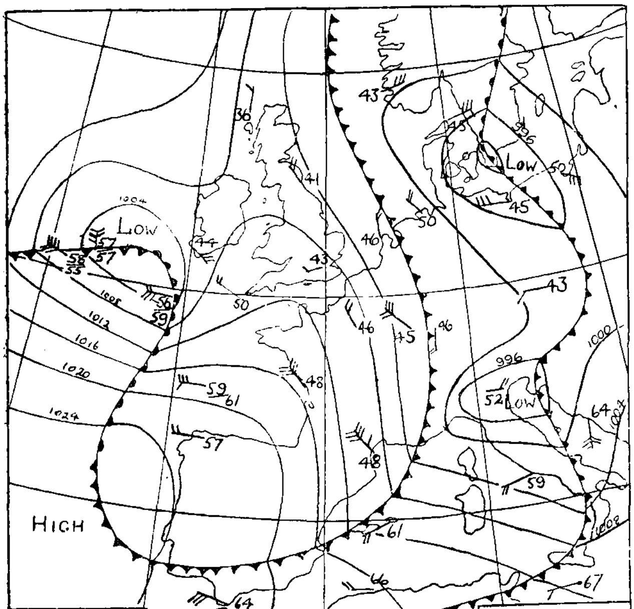
1. Radiation fog, filling the valleys on calm clear nights, and sometimes spreading over the high ground in the early morning as a shallow layer.
2. General fog, covering a large area of country during calm weather in winter. Of the general fogs mentioned during the year in the Meteorological Office *Supplement to the Daily Weather Report*, 13 were observed at Leafield. These were only of moderate thickness; four were greater than 300ft., but none much greater.
3. Low stratus, coming right down on to the high ground, leaving the valleys clear. Does not require calm weather for its formation. Probably most of the fogs whose thickness is much greater than 300ft. are of this type.

G. S. P. Heywood.

The Importance of Atlantic Ship Observations for Mediterranean Forecasting

Although over the central Mediterranean forecasting presents its own peculiar problems it might at least be thought to be free from that source of many past forecast failures in the British Isles: the unknown situation over the Atlantic. As an illustration of the value of Atlantic ship observations at a station so far distant as Malta attention is drawn to the conditions from October 26th to 27th, 1929.

At 7h. G.M.T. on the 26th a depression had formed over north Italy as is normally the case when cold air enters the Mediterranean from France. The cold air had already spread over the Balearics and Sardinia and was expected to reach Malta that night, giving a change from light southwesterly to fresh or strong northwesterly winds. A second cold front was also moving southeastwards across France and was expected to cause further deepening of the depression over Italy. After the arrival of the cold air at Malta a period of showery northwesterly conditions was anticipated. At this time only one ship observation was received from the Atlantic, sufficient to indicate a shallow low somewhere to the west of Ireland but naturally not enough to enable an accurate analysis to be made.



At 13h. G.M.T. changes were taking place as foreseen. The Italian depression had deepened; the first cold front had almost reached Sicily; whilst the second had entered the northwest Mediterranean from France. No change in the morning forecast was thought to be necessary; there appeared to be a distinct possibility of a heavy squall with the arrival of the cold air. At this time again only one ship observation was available from the Atlantic, confirming the existence of an eastward-moving depression west of Ireland but not leading one to anticipate any immediate effect for the central Mediterranean. Three ship observations at 18h. enabled an analysis to be made and it was then seen that the Atlantic depression would influence the Mediterranean shortly. The situation at 18h. on the 26th is shown in the figure with the routine frontal analysis. All information received by wireless telegraphy was used for the analysis but without supplementing from daily weather reports. Temperatures and winds for a few stations only are given in the diagram; ship observations of sea temperatures are plotted below the air temperatures, the difference between air and sea temperatures being a most useful factor in air mass analysis. The depression off the west of Ireland was apparently a development on a wave in the front lying northwestwards across the Atlantic. Subse-

quently it behaved as a normal Bjerknes cyclone and had reached the Bay of Biscay at 7h. on the 27th, the northwest Mediterranean at 18h., the Tyrrhenian Sea at 7h. on the 28th and the Ionian Sea at 18h. on the 28th. The northwest winds at Malta were completely cut off and it was not until after the passage of this depression that the northwesterly conditions really set in, with a squall to 58 m.p.h. about noon on the 28th, some 36 hours later than originally expected.

R. C. SUTCLIFFE.

Review

Annales de l'Observatoire National d'Athènes. Edited by D. Eginitis. Tome X, Size 12 × 9½ in., pp. cvi + 539. *Illus.* Athens, 1929.

This volume deals with the period 1923 to 1926. Summaries are given of astronomical, meteorological and seismographic observations at the Observatory of Athens, also of meteorological observations at 28 second- and third-order stations and at 34 rainfall stations in Greece. There is also a "macroseismic catalogue," a list of earthquake movements, perceptible without instruments, recorded at various places in Greece. In 1926, 122 such were recorded; most of them were of no more than feeble intensity, but the earthquake of June 26th, 1926, caused much damage in Crete, and was felt over a wide area. A number of short papers form an introduction to the volume, of these may be mentioned a note on the Corinth earthquake of April 22nd, 1928, by Professor Eginitis, a note on visibility at Athens by A. N. Livathinos, and a note on air temperature at Athens by T. Th. Fintiklis. The last mentioned determines normals from the observations of 1894-1923. and examines the variability of temperature by statistical methods.

S. T. A. MIRRLEES.

The influence of Sea Disturbance on Surface Temperature. By P. M. van Riel. Koninklijk Nederlandsch Meteorologisch Instituut. No. 102. Mededeelingen en Verhandelingen 30.

For this investigation the data from Dutch ships are used, the selected areas being two in the temperate latitudes of the North Atlantic, one in the equatorial Atlantic, one in the western coastal area of the South Atlantic and one in the equatorial Indian Ocean. The purpose of the inquiry is to determine whether the ordinary bucket method of obtaining sea temperatures gives results that approximate to real surface conditions. This is found to be the case where all observations are utilised for normal values. The consequence of increasing sea disturbance from mean smooth to mean moderate, is a fall of surface temperature of about 0·5°C. in the temperate zone in summer and in the equatorial Indian Ocean. For the equatorial Atlantic the fall is only half this amount. The effect on the decrease of the amplitude of the daily range, which is slight, is also discussed. It is further shown that the effect due to increasing sea disturbance is in general unconnected with the accompanying increase in cloudiness.

E. W. Barlow.

Summary of Indian Rainfall for the Fifty Years, 1875-1924. Memoirs of the Indian Meteorological Department, Vol. XXV, Part II, 1928, pp. 94 + map.

This paper gives for the 15 divisions of India general rainfall amounts for each month of the fifty years, 1875-1924. The values are given both as percentages of the average and as departures in actual inches. If the existing rainfall stations had initially been established uniformly over India and had been continuously maintained with standard instruments in standard exposures, the preparation of such a summary would be relatively simple. Prior to the reorganisation of the meteorological service by Sir John Eliot in 1890, reliable records were few. The increase in the number of stations at this period is illustrated by the figures for Punjab (East and North) which changed from 23 in 1890 to 120 in 1891.

The accuracy of the final results is affected not only by the amount of data, but by the amount of time which can be expended in carrying out each computation. The ideal method involves the preparation of rainfall maps for each district both for the average rainfall and for individual months, and the determination of the general amount by subdividing the whole area into smaller zones for which the rainfall can be estimated by inspection. This method is obviously laborious, and a more practical scheme, and one frequently adopted in this country, is to convert the individual monthly amounts into percentages of the average monthly values and to take a mean. If the stations are uniformly distributed the final value is the mean percentage for that area. If, as is usually the case, the general rainfall for the district month by month is required, then the selection of the stations should be proportional to the average rainfall. There should be more stations in the wet districts, since an excess of say 10 per cent. of the average in a wet region corresponds to more rain than a similar excess at a station in a dry region. In practice, however, it is found that, if stations uniformly distributed are used the errors in the final values are not large, since the percentage values change but slowly from place to place.

A third method has been adopted in this paper. The mean of the actual rainfall amounts is taken, together with the mean of the corresponding averages. This method is obviously not so good, since a station with a very large average exerts too strong an influence, while one with a small average may have practically no effect at all. This difficulty is obviated by the use of percentages. In the paper records from stations at altitudes of more than 3,500ft. had to be omitted in certain cases, although such regions were left relatively unrepresented thereby.

This method of obtaining the general values is a factor which must be taken into account in considering the correlation coefficients which are included in the paper.

A striking feature of the tables is the number of months in which the rainfall over whole districts, which are of the order of 50,000 sq. miles is given as 0 per cent. This occurred in the state of Hyderabad during 17 out of 50 Januaries. On the other hand it is not unusual for the general fall to be between 1,000 and 2,000 per cent. of the average. The rainfall of Hyderabad during January 1922 was 2·52in. which with an average of ·14in. gives a percentage of 1,687. It will be recalled that the correlation coefficient between two sets of data depends very largely on the accord on the occasions of extremes. With so variable a rainfall this point is of particular importance in considering the actual values of the correlations and a long period seems necessary before reliable values can be obtained. The inclusion of one or two dot diagrams would have been of assistance in this connexion and might suggest a classification into types with large and small relationship.

One naturally turns to the tables of correlation coefficients with particular interest because of the use made of them in forecasting by Sir Gilbert Walker. They emphasise that the monsoon rains of Burma have either no relationship, or a slight tendency to vary inversely with the rainfall of other divisions. It is also noticed that with the extension of the period to 50 years the relationship between the rainfall of January to April and that of July, which previously gave a correlation of −·53, is now only −·37. This relationship between winter rains and subsequent monsoon rains is examined in detail and it is shown that the significant correlations are concentrated in March.

J. GLASSPOOLE.

Books Received

Bulletin Météorologique du departement de l'Hérault publié sous les auspices du Conseil Général. Années 1924-5. Montpellier, 1928.

Apia Observatory, Samoa. Report for 1926. Wellington, 1929.

Deutsches Meteorologisches Jahrbuch, 1926, Freie Hansestadt Bremen. Edited by Dr. A. Mey, Bremen, 1928.

Deutsches Meteorologisches Jahrbuch für 1919-20, Freistaat Sachsen. Edited by Prof. Dr. E. Alt, Dresden, 1928.

News in Brief

Dr. Louis A Bauer, Director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington since the establishment of the department on April 1st, 1904, retired from this position on January 1st, 1930, with the title of director emeritus. He is succeeded by Mr. John A. Fleming, with the title of acting director.

Corrigendum

January, 1930, p. 277, lines 14-18, and p. 279, lines 28-31. The temperature and sunshine records at Rothamsted date back to 1878 and 1890 respectively, and not as stated to 1852. The earliest records at this station are those of rainfall, which has been measured continuously with the same gauge since February, 1853.

The Weather of January, 1930

The weather of January was unsettled and wet with frequent gales during the first fortnight. Pressure was almost continuously low south of Iceland, the average pressure for the month being more than 10 mb. below normal over Scotland and Ireland, and slightly less than 10mb. in England. Winds were for the most part between south and west and the temperature high for the time of year in England, and often also in Scotland and Ireland. Maxima frequently exceeded 50° F.; on the 7th they reached 54° F. at Aberdeen, 56° F. at Dublin and Manchester, and on the 19th 60° F. at Bath and 59° F. at Greenwich; the latter was a record since 1841. Only on a few occasions were the maxima generally below 40° F. even in Scotland, *e.g.*, on the 11th-15th, during which period the lowest maximum was 33° F. at Nairn and Birr Castle on the 11th and on the 25th-28th during which the lowest maxima were 33° F. at Renfrew and 34° F. at Harrogate and Armagh on the 26th. Minimum temperatures also were often high in the south, 50° F. being recorded locally on the 14th and 19th, but there were several severe frosts notably on the 16th, 21st, 26th, 28th and 31st, 10° F. was recorded on the ground at Burnley on the 16th, 12° F. on the 21st and 14° F. on the 28th and 31st. High winds and gales were experienced throughout the month, but were most frequent and widespread during the first fortnight. The most severe gale occurred on the 12th.* The total rainfall was excessive except at a few places on the east coast. At Ross-on-Wye the total was the highest since 1869, and at Valentia the record has been broken for each of the three successive months November, December and January. From about the 15th-21st there was a period of little or no rain in the south, but in other districts precipitation (though sometimes slight) occurred on most days throughout the month. Among the heaviest falls were 3·20 in. at Fofanny (Co. Down) on the 31st, 2·45 in. at Rosthwaite (Cumberland) on the 1st, 2·33 in. at Tynywaun (Glamorgan) on the 10th, and 2·30 in. at Achnacarry (Inverness) on the 6th. Snow was reported from various parts of Scotland, Ireland and north England from about the 9th to 16th, and again from the 27th-30th, with snow lying to a depth of 1½ in. at Inverness and Rothesay on the 11th and 2 in. at Marchmont on the 27th. Thunderstorms occurred at isolated places on the 1st-3rd, on the 11th and on the 26th-28th. Mist or fog were widespread on the 16th and on the mornings of the 21st and 26th-31st. The sunniest days of the month were the 2nd, 6th, 15th, 20th, 25th, 29th and 30th; 7·1 hrs. were recorded at Ventnor and Eastbourne on the 6th, 7·0 hrs. at Blackpool and Southport on the 15th and 8·2 hrs. at Weymouth on the 29th. The distribution of sunshine for the month was as follows:—

---

* See page 1.

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs).
Stornoway	30	+ 2	Valentia	45	− 3
Aberdeen	67	+19	Liverpool	57	+ 2
Dublin	55	− 2	Falmouth	58	0
Birr Castle	55	+ 6	Kew	42	− 1

Pressure was below normal over western and northern Europe, Spitsbergen, Iceland and the northeastern part of the North Atlantic the greatest deficit being 16·9mb. at Thorshavn (Faeroes), and above normal in Newfoundland, Bermuda and the Azores, the greatest excess being 9·2mb. at St. John's. Temperature was above normal over western Europe, being as much as 13°F. in excess at Haparanda. Rainfall, except over the British Isles and parts of Sweden was generally deficient.

Owing to the wet weather large boulders fell from the top of the "Rock" of Gibraltar above the village of Caleta, causing extensive damage to the rainwater catchments. Severe storms were experienced off the southern Norwegian coasts about the 10th. Very mild weather prevailed in Scandinavia, Finland and north Russia throughout the month with very little ice in the Baltic. The föhn wind was experienced in Switzerland from the 27th-31st, with the result that the snow melted up to a level of at least 3,000 ft. and temperature rose above 60° F. in the valleys of the Rhine and Reuss. Owing to heavy rain during the later part of the month floods occurred in several low-lying parts of the Riviera, but these were subsiding by the 29th. Gales were experienced in the southern part of the Bay of Biscay on the 27th and at Gibraltar on the 31st.

Unprecedented floods at Kidete (some 25 miles west of Kilosa) following heavy rain stopped all railway communication between

Dar-es-Salaam and Dodoma on the 6th. The level of Gombo Lake at Kidete Station on the 10th was 5½ ft. above the rails, 3 miles of which were under water and rain was still falling. By the 22nd the floods were subsiding steadily. A southeasterly gale occurred at Cape Town from the 18th to 21st, and a storm was also experienced in Rif on the 25th.

In consequence of heavy rains in Central Australia and the pastoral districts of Queensland the river Finke is running for the first time in seven years, and the Bulloo, Warrego and Thomson rivers and Cooper's Creek are several miles wide, the flood water from the latter reaching Lake Eyre for the first time for 10 years. The damage to the railway and towns is regarded as nothing compared with the great benefit the rains will ensure for years to the stock. A sudden severe blizzard with thunder and lightning occurred on Mount Cook, New Zealand, on the 19th, during which six people were killed near the Tasman glacier.

From the 1st-9th central Canada and the eastern States experienced generally mild weather; temperature reached 66° at New York on the 9th, and many rivers were free of ice. A cold spell swept across the western States about the 5th, extended to the Mississippi River area before the 14th, to the Atlantic States, the following week, and continued over the most of the States until the end of the month. Several deaths occurred from cold on the 18th-23rd, when the temperature continued below 0°F. at many places throughout the day. Precipitation was slight at first but was afterwards heavy, floods resulting in the Mississippi river area from the 10th. Heavy snowfalls later in the month intensified the sufferings of the flood victims. A storm was experienced at Sao Paulo, Brazil, on the 11th and four people were killed in a cyclone at Cordoba, Argentina, on the 29th.

The special message from Brazil states that the rainfall was scarce over the whole country with an average of 0·16in., 3·58in. and 0·87in. below normal in the northern, central and southern regions respectively. Six anticyclones passed across the country. The proximity of the Atlantic anticyclones to the east coast caused excessive heat and little rain over most of the country. Crops were generally in good condition except the cereals in the south, which were suffering from lack of rain. At Rio de Janeiro pressure was 0·5mb. above normal and temperature 2.5°F. above normal.

Rainfall, January, 1930.—General Distribution

	Year	
England and Wales	170	per cent of the average 1881-1915.
Scotland	131	
Ireland	152	
British Isles	157	

Rainfall: January, 1930: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	2·51	135	*Leics* .	Belvoir Castle	2·76	156
Sur .	Reigate, Alvington	3·76	157	*Rut* .	Ridlington	2·91	...
Kent .	Tenterden, Ashenden	2·83	133	*Linc* .	Boston, Skirbeck	1·93	119
,, .	Folkestone, Boro. San.	2·45	...	,, .	Lincoln	...	...
,, .	Margate, Cliftonville	2·02	122	,, .	Skegness, Marine Gdns	1·56	90
,, .	Sevenoaks, Speldhurst	3·19	...	,, .	Louth, Westgate	2·73	126
Sus .	Patching Farm	3·83	147	,, .	Brigg, Wrawby St.	2·60	...
,, .	Brighton, Old Steyne	2·86	118	*Notts* .	Worksop, Hodsock	3·13	177
,, .	Heathfield, Barklye	4·84	179	*Derby* .	Derby, L. M. & S. Rly.	3·60	180
Hants .	Ventnor, Roy. Nat. Hos.	4·43	172	,, .	Buxton, Devon Hos.	6·33	142
,, .	Fordingbridge, Oaklnds	4·96	180	*Ches* .	Runcorn, Weston Pt.	4·01	169
,, .	Ovington Rectory	6·19	229	,, .	Nantwich, Dorfold Hall	4·66	...
,, .	Sherborne St. John	4·15	178	*Lancs* .	Manchester, Whit. Pk.	4·02	160
Berks .	Wellington College	...	...	,, .	Stonyhurst College	6·06	142
,, .	Newbury, Greenham	4·25	184	,, .	Southport, Hesketh Pk	4·88	191
Herts .	Welwyn Garden City	1·98	...	,, .	Lancaster, Strathspey	6·56	...
Bucks .	High Wycombe	3·97	190	*Yorks* .	Wath-upon-Dearne	3·15	164
Oxf .	Oxford, Mag. College	2·47	145	,, .	Bradford, Lister Pk.	5·43	189
Nor .	Pitsford, Sedgebrook	3·20	172	,, .	Oughtershaw Hall	13·05	...
,, .	Oundle	1·78	...	,, .	Wetherby, Ribston H.	4·20	204
Beds .	Woburn, Crawley Mill	2·69	157	,, .	Hull, Pearson Park	2·50	139
Cam .	Cambridge, Bot. Gdns.	1·64	109	,, .	Holme-on-Spalding	2·75	...
Essex .	Chelmsford, County Lab	1·81	118	,, .	West Witton, Ivy Ho.	6·47	...
,, .	Lexden Hill House	1·74	...	,, .	Felixkirk, Mt. St. John	3·99	199
Suff .	Hawkedon Rectory	1·85	106	,, .	Pickering, Hungate	3·44	...
,, .	Haughley House	1·32	...	,, .	Scarborough	2·99	149
Norf .	Norwich, Eaton	1·91	97	,, .	Middlesbrough	2·71	169
,, .	Wells, Holkham Hall	1·70	117	,, .	Baldersdale, Hury Res.	6·37	...
,, .	Little Dunham	2·09	107	*Durh* .	Ushaw College	3·35	163
Wilts .	Devizes, Highclere	4·28	197	*Nor* .	Newcastle, Town Moor	3·21	157
,, .	Bishops Cannings	3·76	164	,, .	Bellingham, Highgreen	4·06	...
Dor .	Evershot, Melbury Ho.	8·29	238	,, .	Lilburn Tower Gdns.	2·70	...
,, .	Creech Grange	4·33	...	*Cumb* .	Geltsdale	5·60	...
,, .	Shaftesbury, Abbey Ho.	3·93	151	,, .	Carlisle, Scaleby Hall	4·40	178
Devon .	Plymouth, The Hoe	6·22	187	,, .	Borrowdale, Seathwaite	21·75	164
,, .	Polapit Tamar	7·04	189	,, .	Borrowdale, Rosthwaite	19·03	...
,, .	Ashburton, Druid Ho.	...	...	,, .	Keswick, High Hill	9·97	...
,, .	Cullompton	6·11	188	*Glam* .	Cardiff, Ely P. Stn.	6·22	165
,, .	Sidmouth, Sidmount	...	...	,, .	Treherbert. Tynywaun	18·14	...
,, .	Filleigh, Castle Hill	6·47	...	*Carm* .	Carmarthen Friary	9·56	218
,, .	Barnstaple. N. Dev. Ath.	5·77	176	,, .	Llanwrda	9·83	184
Corn .	Redruth, Trewirgie	8·41	199	*Pemb* .	Haverfordwest, School	8·61	...
,, .	Penzance, Morrab Gdn.	8·23	217	*Card* .	Aberystwyth	5·69	...
,, .	St. Austell, Trevarna	8·11	190	,, .	Cardigan, County Sch.	7·39	...
Soms .	Chewton Mendip	6·17	161	*Brec* .	Crickhowell, Talymaes	9·20	...
,, .	Long Ashton	5·33	...	*Rad* .	Birm W. W. Tyrmynydd	10·31	164
,, .	Street, Millfield	3·46	...	*Mont* .	Lake Vyrnwy	8·88	157
Glos. .	Cirencester, Gwynfa	4·68	187	*Denb* .	Llangynhafal	5·46	...
Here .	Ross, Birchlea	5·07	210	*Mer* .	Dolgelly, Bryntirion	9·25	163
,, .	Ledbury, Underdown	4·60	209	*Carn* .	Llandudno	4·75	184
Salop .	Church Stretton	6·68	264	,, .	Snowdon, L. Llydaw 9	...	...
,, .	Shifnal, Hatton Grange	4·02	207	*Ang* .	Holyhead, Salt Island	5·87	202
Worc .	Ombersley, Holt Lock	4·35	226	,, .	Lligwy	5·56	...
,, .	Blockley	4·79	...	*Isle of Man*			
War .	Farnborough	4·65	216		Douglas, Boro' Cem.	6·37	190
,, .	Birminghm, Edgbaston	4·97	246	*Guernsey*			
Leics .	Thornton Reservoir	3·34	169		St. Peter P't. Grange Rd.	5·98	204

Rainfall: January, 1930: Scotland and Ireland

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent of Av.
Wigt .	Stoneykirk, Ardwell Ho	...	...	*Suth* .	Loch More, Achfary	10·02	138
,, .	Pt. William, Monreith	5·64	...	*Caith* .	Wick	2·01	81
Kirk .	Carsphairn, Shiel	12·66	...	*Ork* .	Pomona, Deerness	3·08	89
,, .	Dumfries, Cargen	6·95	174	*Shet* .	Lerwick	5·80	136
Dumf.	Eskdalemuir Obs.	10·84	200	*Cork* .	Caheragh Rectory	9·60	...
Roxb .	Branxholm	5·68	207	,, .	Dunmanway Rectory	11·48	184
Selk .	Ettrick Manse	10·14	...	,, .	Ballinacurra	4·86	122
Peeb .	West Linton	4·75	...	,, .	Glanmire, Lota Lo.	6·74	157
Berk .	Marchmont House	2·12	94	*Kerry*.	Valentia Obsy.	10·96	200
Hadd.	North Berwick Res.	1·69	98	,, .	Gearahameen	18·30	...
Midl .	Edinburgh, Roy. Obs.	3·03	176	,, .	Killarney Asylum	...	...
Ayr .	Kilmarnock, Agric. C.	4·89	143	,, .	Darrynane Abbey	8·52	170
,, .	Girvan, Pinmore	6·18	131	*Wat* .	Waterford, Brook Lo	4·97	135
Renf .	Glasgow, Queen's Pk.	5·59	167	*Tip* .	Nenagh, Cas. Lough	7·56	191
,, .	Greenock, Prospect H.	10·61	155	,, .	Roscrea, Timoney Park	5·42	...
Bute .	Rothesay, Ardencraig.	5·83	130	,, .	Cashel, Ballinamona	5·73	151
,, .	Dougarie Lodge	4·85	...	*Lim* .	Foynes, Coolnanes	7·98	211
Arg .	Ardgour House	18·00	...	,, .	Castleconnel Rec.	5·74	...
,, .	Manse of Glenorchy	12·66	...	*Clare* .	Inagh, Mount Callan	8·40	...
,, .	Oban	8·79	...	,, .	Broadford, Hurdlest'n.	6·86	...
,, .	Poltalloch	6·96	137	*Wexf*.	Newtownbarry	...	...
,, .	Inveraray Castle	12·23	149	,, .	Gorey, Courtown Ho	5·44	174
,, .	Islay, Eallabus	6·78	145	*Kilk* .	Kilkenny Castle	4·59	143
,, .	Mull, Benmore	...	...	*Wic* .	Rathnew, Clonmannon	5·46	...
,, .	Tiree	...	...	*Carl* .	Hacketstown Rectory	5·21	147
Kinr .	Loch Leven Sluice	3·59	114	*Leix* .	Blandsfort House	6·02	183
Perth .	Loch Dhu	13·85	152	,, .	Mountmellick	6·11	...
,, .	Balquhidder, Stronvar	14·35	...	*Off'ly* .	Birr Castle	4·92	174
,, .	Crieff, Strathearn Hyd.	5·19	129	*Dubl* .	Dublin, FitzWm. Sq	3·58	156
,, .	Blair Castle Gardens	5·52	166	,, .	Balbriggan, Ardgillan.	4·13	180
,, .	Dalnaspidal Lodge	...	...	*Me'th* .	Beauparc, St. Cloud	4·06	...
Angus.	Kettins School.	3·68	155	,, .	Kells, Headfort	4·64	147
,, .	Dundee, E. Necropolis	1·97	101	*W.M*.	Moate, Coolatore	3·37	...
,, .	Pearsie House	2·85	...	,, .	Mullingar, Belvedere.	4·16	130
,, .	Montrose, Sunnyside	1·74	87	*Long* .	Castle Forbes Gdns	4·62	139
Aber .	Braemar, Bank	4·30	135	*Gal* .	Ballynahinch Castle	9·03	145
,, .	Logie Coldstone Sch.	2·31	104	,, .	Galway, Grammar Sch.	4·47	...
,, .	Aberdeen, King's Coll.	1·85	85	*Mayo* .	Mallaranny	7·81	...
,, .	Fyvie Castle	2·25	...	,, .	Westport House	6·78	146
Moray.	Gordon Castle	1·66	82	,, .	Delphi Lodge	16·71	...
,, .	Grantown-on-Spey	2·63	109	*Sligo* .	Markree Obsy	4·25	108
Nairn.	Nairn, Delnies	2·14	108	*Cav'n*.	Belturbet, Cloverhill	3·69	123
Inv .	Kingussie, The Birches	5·25	...	*Ferm* .	Enniskillen, Portora	3·13	...
,, .	Loch Quoich, Loan	20·75	...	*Arm* .	Armagh Obsy	4·02	160
,, .	Glenquoich	19·92	145	*Down*.	Fofanny Reservoir	13·02	...
,, .	Inverness, Culduthel R.	3·09	...	,, .	Seaforde	4·82	156
,, .	Arisaig, Faire-na-Squir	7·92	...	,, .	Donaghadee, C. Stn	4·43	174
,, .	Fort William	16·53	...	,, .	Banbridge, Milltown	4·13	...
,, .	Skye, Dunvegan	9·32	...	*Antr* .	Belfast, Cavehill Rd	4·12	...
R & C.	Alness, Ardross Cas	4·01	106	,, .	Glenarm Castle	5·76	...
,, .	Ullapool	6·11	...	,, .	Ballymena, Harryville	4·70	127
,, .	Torridon, Bendamph	14·66	156	*Lon* .	Londonderry, Creggan	4·20	117
,, .	Achnashellach	12·89	...	*Tyr* .	Donaghmore	4·88	...
,, .	Stornoway	6·62	128	,, .	Omagh, Edenfel	4·51	127
Suth .	Lairg	2·99	...	*Don* .	Malin Head	4·36	...
,, .	Tongue	3·73	95	,, .	Dunfanaghy	6·61	...
,, .	Melvich	5·00	...	,, .	Killybegs, Rockmount.	4·60	82

Climatological Table for the British Empire, August, 1929.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute Max.	Absolute Min.	Mean Values Max	Mean Values Min.	Mean Values ½ max. and min.	Mean Values Diff. from Normal	Mean Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1016·1	+ 0·8	85	47	70·5	54·0	62·3	+ 0·7	55·1	85	6·3	2·16	— 0·08	9	6·0	42
Gibraltar	1015·5	— 1·2	91	64	83·8	68·5	76·1	+ 0·1	67·2	83	4·8	0·04	— 0·09	1	..	..
Malta	1014·4	— 0·9	88	68	82·4	72·0	77·2	— 1·9	72·4	81	2·0	0·04	— 0·10	1	11·6	86
St. Helena	1016·5	+ 2·8	61	52	56·6	53·6	55·1	— 2·8	54·9	93	8·9	2·69	— 1·03	23	..	..
Sierra Leone	1014·4	+ 1·7	84	69	80·5	72·1	76·3	— 1·6	73·6	89	6·3	29·00	— 7·57	26	..	..
Lagos, Nigeria	1012·8	— 0·8	87	71	82·8	73·2	78·0	+ 0·3	73·4	83	9·0	0·81	— 1·99	10	..	..
Kaduna, Nigeria	1015·9	+ 2·1	86	..	82·3	..	..	..	69·0	85	..	19·66	+ 9·98	27	..	..
Zomba, Nyasaland	1017·6	+ 0·8	84	47	72·2	54·3	63·3	— 1·6	..	69	5·3	0·70	+ 0·33	5	..	..
Salisbury, Rhodesia	1018·4	+ 0·5	82	36	71·1	44·9	58·0	— 2·2	48·6	43	2·1	0·00	— 0·08	0	9·9	86
Cape Town	1020·8	+ 0·6	78	39	64·4	51·1	57·7	+ 2·1	51·4	86	4·9	1·94	— 1·43	10	..	..
Johannesburg	1023·7	+ 0·9	80	31	64·0	41·7	52·9	— 1·4	40·7	50	1·8	0·00	— 0·51	0	9·7	87
Mauritius	1020·3	— 0·2	77	57	73·9	62·2	68·1	— 0·4	64·6	72	4·8	2·17	— 0·18	25	7·5	66
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calcutta, Alipore Obsy.	1000·5	— 0·5	92	77	88·8	78·8	83·8	+ 0·8	79·3	90	8·5	11·29	— 1·40	18*	..	..
Bombay	1005·9	0·0	87	74	85·9	76·5	81·2	+ 0·5	76·1	82	8·5	6·06	— 8·39	16*	..	..
Madras	1005·2	— 0·3	99	74	94·2	77·6	85·9	0·0	75·5	74	7·1	4·48	— 0·16	9*	..	..
Colombo, Ceylon	1010·3	+ 0·6	87	72	85·2	76·6	80·9	— 0·2	76·3	77	7·8	0·31	— 2·82	4	6·8	55
Hongkong	1004·2	— 0·9	91	75	85·8	77·6	81·7	— 0·4	78·2	84	7·6	20·02	+ 5·97	20	5·8	45
Sandakan	..	..	92	74	89·5	75·3	82·4	+ 0·6	77·3	82	..	2·83	— 5·23	4	..	..
Sydney, N.S.W.	1018·3	+ 0·1	80	39	64·5	46·5	55·5	+ 0·5	48·9	70	4·0	3·90	+ 0·89	14	6·9	63
Melbourne	1017·6	— 0·5	68	30	57·4	42·4	49·9	— 1·2	45·4	75	6·5	2·00	+ 0·19	18	4·4	41
Adelaide	1018·6	— 0·7	71	36	60·5	44·3	52·4	— 1·6	46·8	65	5·3	1·51	— 1·00	15	5·9	55
Perth, W. Australia	1018·9	+ 0·1	77	42	63·5	48·6	56·1	+ 0·2	50·2	69	4·9	3·34	— 2·28	18	7·0	64
Coolgardie	1019·8	+ 0·5	75	33	63·2	41·1	52·1	— 1·5	45·1	58	3·7	0·47	— 0·55	6	..	..
Brisbane	1019·9	+ 0·7	83	42	71·8	50·8	61·3	+ 0·9	54·2	67	3·2	0·95	— 1·18	4	8·7	79
Hobart, Tasmania	1013·4	— 0·2	63	32	55·7	39·9	47·8	— 0·2	42·3	70	6·2	0·65	— 1·19	13	5·4	52
Wellington, N.Z.	1016·7	+ 1·6	61	35	51·5	41·8	46·7	— 1·9	44·4	78	6·5	5·39	+ 0·90	16	5·0	48
Suva, Fiji	1014·7	+ 0·4	86	62	77·4	68·3	72·9	— 0·8	68·5	79	7·9	10·48	+ 2·24	21	3·5	30
Apia, Samoa	1011·9	— 0·3	86	68	83·2	73·7	78·5	+ 0·7	74·6	73	4·9	2·89	— 0·26	10	7·9	68
Kingston, Jamaica	1013·5	0·0	93	70	88·6	73·6	81·1	— 0·4	72·5	86	4·2	6·27	+ 2·72	10	8·1	64
Grenada, W.I.	1009·8	— 2·8	90	71	87·2	73·8	80·5	+ 1·0	74·5	86	5·2	8·22	— 1·36	24	..	..
Toronto	1015·6	+ 0·2	88	49	75·5	55·3	65·4	— 1·2	57·8	71	3·7	1·94	— 0·83	9	8·7	62
Winnipeg	1014·7	+ 0·8	100	37	81·9	54·7	68·3	+ 5·3	54·4	83	3·9	0·55	— 1·89	5	9·6	66
St. John, N.B.	1013·6	— 1·8	77	49	68·9	54·3	61·6	+ 1·0	57·3	79	5·3	3·34	— 0·52	12	7·2	51
Victoria, B.C.	1017·2	0·0	84	49	68·1	52·2	60·1	0·0	55·5	77	3·7	0·26	— 0·39	2	10·3	72

ERRATA.—The Observations for London, Kew Observatory for January 1928 and Year 1928 *should read*:—

Climatological Table for the British Empire, August, 1929.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb							
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1016·1	+ 0·8	85	47	70·5	54·0	62·3	+ 0·7	55·1	85	6·3	2·16	— 0·08	9	6·0	42
Gibraltar	1015·5	— 1·2	91	64	83·8	68·5	76·1	+ 0·1	67·2	83	4·8	0·04	— 0·09	1	..	..
Malta	1014·4	- 0·9	88	68	82·4	72·0	77·2	— 1·9	72·4	81	2·0	0·04	— 0·10	1	11·6	86
St. Helena	1016·5	+ 2·8	61	52	56·6	53·6	55·1	— 2·8	54·9	93	8·9	2·69	— 1·03	23	..	..
Sierra Leone	1014·4	+ 1·7	84	69	80·5	72·1	76·3	— 1·6	73·6	89	6·3	29·00	— 7·57	26	..	..
Lagos, Nigeria	1012·8	— 0·8	87	71	82·8	73·2	78·0	+ 0·3	73·4	83	9·0	0·81	— 1·99	10	..	..
Kaduna, Nigeria	1015·9	+ 2·1	86	..	82·3	..	..	..	69·0	85	..	19·66	+ 9·98	27	..	..
Zomba, Nyasaland	1017·6	+ 0·8	84	47	72·2	54·3	63·3	— 1·6	..	69	5·3	0·70	+ 0·33	5	..	..
Salisbury, Rhodesia	1018·4	+ 0·5	82	36	71·1	44·9	58·0	— 2·2	48·6	43	2·1	0·00	— 0·08	0	9·9	86
Cape Town	1020·8	+ 0·6	78	39	64·4	51·1	57·7	+ 2·1	51·4	86	4·9	1·94	— 1·43	10	..	..
Johannesburg	1023·7	+ 0·9	80	31	64·0	41·7	52·9	— 1·4	40·7	50	1·8	0·00	— 0·51	0	9·7	87
Mauritius	1020·3	— 0·2	77	57	73·9	62·2	68·1	— 0·4	64·6	72	4·8	2·17	— 0·18	25	7·5	66
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calcutta, Alipore Obsy.	1000·5	— 0·5	92	77	88·8	78·8	83·8	+ 0·8	79·3	90	8·5	11·29	— 1·40	18*	..	..
Bombay	1005·9	0·0	87	74	85·9	76·5	81·2	+ 0·5	76·1	82	8·5	6·06	— 8·39	16*	..	..
Madras	1005·2	— 0·3	99	74	94·2	77·6	85·9	0·0	75·5	74	7·1	4·48	— 0·16	9*	..	..
Colombo, Ceylon	1010·3	+ 0·6	87	72	85·2	76·6	80·9	— 0·2	76·3	77	7·8	0·31	— 2·82	4	6·8	55
Hongkong	1004·2	— 0·9	91	75	85·8	77·6	81·7	— 0·4	78·2	84	7·6	20·02	+ 5·97	20	5·8	45
Sandakan	..	..	92	74	89·5	75·3	82·4	+ 0·6	77·3	82	..	2·83	— 5·23	4	..	..
Sydney, N.S.W.	1018·3	+ 0·1	80	39	64·5	46·5	55·5	+ 0·5	48·9	70	4·0	3·90	+ 0·89	14	6·9	63
Melbourne	1017·6	— 0·5	68	30	57·4	42·4	49·9	— 1·2	45·4	75	6·5	2·00	+ 0·19	18	4·4	41
Adelaide	1018·6	— 0·7	71	36	60·5	44·3	52·4	— 1·6	46·8	65	5·3	1·51	— 1·00	15	5·9	55
Perth, W. Australia	1018·9	+ 0·1	77	42	63·5	48·6	56·1	+ 0·2	50·2	69	4·9	3·34	— 2·28	18	7·0	64
Coolgardie	1019·8	+ 0·5	75	33	63·2	41·1	52·1	— 1·5	45·1	58	3·7	0·47	— 0·55	6	..	..
Brisbane	1019·9	+ 0·7	83	42	71·8	50·8	61·3	+ 0·9	54·2	67	3·2	0·95	— 1·18	4	8·7	79
Hobart, Tasmania	1013·4	— 0·2	63	32	55·7	39·9	47·8	— 0·2	42·3	70	6·2	0·65	— 1·19	13	5·4	52
Wellington, N.Z.	1016·7	+ 1·6	61	35	51·5	41·8	46·7	— 1·9	44·4	78	6·5	5·39	+ 0·90	16	5·0	48
Suva, Fiji	1014·7	+ 0·4	86	62	77·4	68·3	72·9	— 0·8	68·5	79	7·9	10·48	+ 2·24	21	3·5	30
Apia, Samoa	1011·9	— 0·3	86	68	83·2	73·7	78·5	+ 0·7	74·6	73	4·9	2·89	— 0·26	10	7·9	68
Kingston, Jamaica	1013·5	0·0	93	70	88·6	73·6	81·1	- 0·4	72·5	86	4·2	6·27	+ 2·72	10	8·1	64
Grenada, W.I.	1009·8	— 2·8	90	71	87·2	73·8	80·5	+ 1·0	74·5	86	5·2	8·22	- 1·36	24	..	..
Toronto	1015·6	+ 0·2	88	49	75·5	55·3	65·4	— 1·2	57·8	71	3·7	1·94	- 0·83	9	8·7	62
Winnipeg	1014·7	+ 0·8	100	37	81·9	54·7	68·3	+ 5·3	54·4	83	3·9	0·55	— 1·89	5	9·6	66
St. John, N.B.	1013·6	— 1·8	77	49	68·9	54·3	61·6	+ 1·0	57·3	79	5·3	3·34	— 0·52	12	7·2	51
Victoria, B.C.	1017·2	0·0	84	49	68·1	52·2	60·1	0·0	55·5	77	3·7	0·26	— 0·39	2	10·3	72

ERRATA.—The Observations for London, Kew Observatory for January 1928 and Year 1928 *should read* :—

M.O. 326.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 65
Mar.
1930
No. 770

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH; YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 15, DONEGALL SQUARE WEST, BELFAST; or through any Bookseller.

The Weather of the Past Winter—Some Comparisons

The winter of 1929-30 was characterised by an abrupt change from extraordinarily mild, stormy and rainy weather in December and January to very dry and rather cold weather in February, with persistent northeasterly winds over England. The change in the pressure distribution was equally marked; in December and January pressure was more than 15mb. below normal between Iceland and the Faeroes, in February pressure was more than 10mb. above normal over the Faeroes and Shetlands. The deviations of pressure from normal in each of these three months are shown on the right-hand side of Fig. 1, which brings out very clearly the almost complete reversal between January and February.

Reversals of this nature, associated with a sudden and complete change in the general type of weather over the British Isles, are not infrequent, though they are probably more common in spring than in winter. An interesting example occurred in March and April, 1912, a deficit of 10mb. in March giving place to an excess of 10mb. in April, when rainy stormy weather was replaced by quiet anticyclonic conditions with complete rainlessness.* A detailed study of this case showed that the excess of pressure had travelled slowly northeastward from the Azores, at the same time growing more intense, and it is probable that the

---

* *London, Q.J.R. Meteor. Soc.*, 52, 1926, *p.* 263.

(88569) P.S. 14/89 1,050 3/30 M. & S. *Gp.303*

change in 1930 was brought about in the same way, for pressure at Horta in January was 6·5mb. above normal.

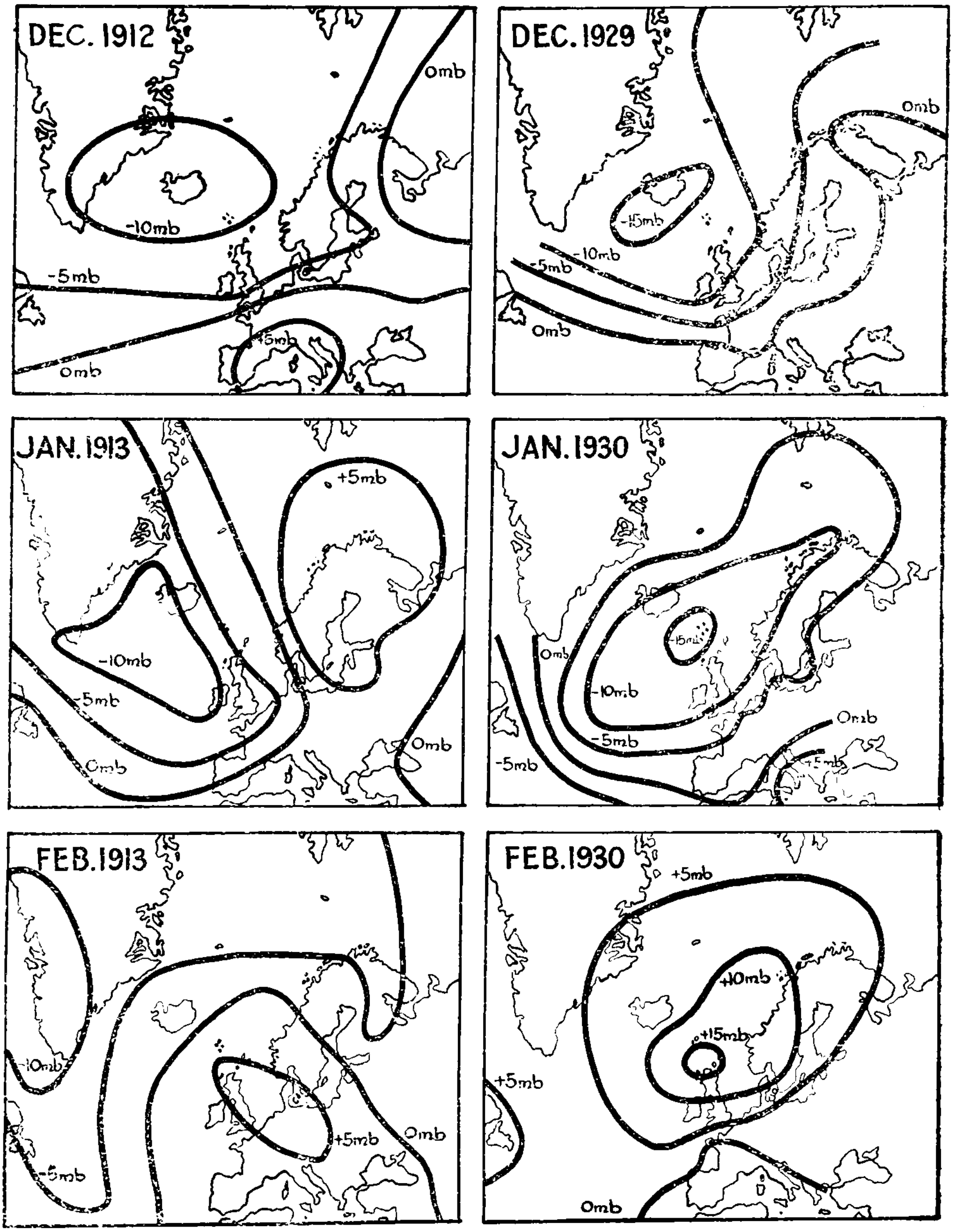
Although February, 1930, was dry, it has not been especially cold, in that respect comparing favourably with February, 1895, which had a distribution of pressure at first sight rather similar. The deviations from normal in the latter month were illustrated in the *Meteorological Magazine* for May, 1924, p. 80. Pressure was more than 15mb. above normal over Iceland, and about normal over the English Channel, giving a month of strong easterly winds. The difference between the two months probably lay in the pressure distribution over Europe, which in 1895, and again in February, 1929, permitted a continuous stream of cold air from eastern Europe and Siberia to reach these islands. A chart showing the actual distribution of pressure in February, 1930, as distinct from a chart of deviations from normal, shows a narrow ridge of high pressure extending from the Azores northeastward across the British Isles to southern Scandinavia, where it exceeded 1,024mb. Over the rest of Europe the pressure gradients were on the average slight and irregular, and there was no continuous current from Siberia. Probably much of the air which formed our northeast winds came as a descending current from higher levels of the atmosphere, the remainder coming partly from the northern North Atlantic, partly from the eastern Mediterranean, and only to a very small extent from Russia. It is interesting to note that the pressure distribution during February, 1930, resembled rather closely that during January, 1929, which was not nearly so cold as the following month.

The most striking parallel, however, lies between the winter of 1929-30 and that of 1912-3. The charts of pressure deviations are shown side by side in Fig. 1, and the similarity is apparent at a glance. The weather sequence also was closely similar, as is shown by the headings from the corresponding issues of the *Monthly Weather Report* :—

	1912-3.	1929-30.
December	Stormy and mild.	Mild, abnormally wet and Stormy, but with frequent sunny periods.
January	Stormy and wet.	Mild and wet. Violent gales on 1st to 3rd and on 12th.
February	Cloudy and dry—one foggy week.	—

The official epigram on February, 1930, has yet to be composed, but the particulars given on p. 51 of this issue show that the weather was cold and dry and cloudy in England, though fortunately we escaped the week of fog.

There is one other point of similarity between 1929-30 and 1912-3, which may or may not be relevant. The spring months of both 1912 and 1929 were remarkable for the enormous numbers of icebergs which were carried by the Labrador Current over the Newfoundland Banks and into the North Atlantic. In this respect these two years stand almost in a class apart, though 1905 was somewhat similar. It should be noted, however, that the winter of 1905-6 presented no particular resemblance to 1929-30.


DEC. 1912
Omb
-10mb
-5mb
+5mb
Omb
DEC. 1929
Omb
-15mb
-10mb
-5mb
Omb
JAN. 1913
+5mb
-10mb
-5mb
Omb
Omb
JAN. 1930
-15mb
Omb
-10mb
-5mb
Omb
-5mb
+5mb
FEB. 1913
-10mb
-5mb
+5mb
Omb
FEB. 1930
+5mb
+10mb
+15mb
+5mb
Omb

Pressure Anomalies in two Winters.

Over the continent of Europe, as in Great Britain, the months of December and January were abnormally warm, the temperature from Warsaw to the Rhine averaging about 6°F. above normal in both months. December was rainy in almost all districts, but January was remarkably dry, only small parts of Germany and Austria exceeding the normal rainfall. Such information as is available for February is given on p. 52.

C. E. P. Brooks.

The Heavy Rain of November 11th, 1929

By J. Glasspoole, Ph.D.

In view of the large rainfall amounts reported from the Rhondda Valley during November and December, 1929, an inspection was authorised by the Director of the Meteorological Office, and on December 19th and 20th I visited Pontypridd and the two valleys immediately to the north.

The largest amounts for November 11th (*i.e.*, for the 24 hours commencing at 9 a.m. on the 11th) are :—

	in.
Rhondda (Lluest Wen Reservoir)	8·31
,, (Lluest Wen Filter)	6·20
Treherbert (Tynywaun)	5·25
Llyn Fawr Reservoir	4·98
Glyncorrwg Colliery	4·93
Rhondda (Castell Nos Reservoir)	4·72

All the stations are in Glamorgan and the actual values are shown on the map. The catchment area of the two streams draining to Porth is indicated, together with the contours of 500, 1,000 and 1,500 feet, and the isohyetal lines showing the probable distribution of the rainfall over the valleys are given.

In the British Isles, falls exceeding 8in. in a single rain-day are very rare and one of the main objects of the inspection was to see if there was any reason to doubt the authenticity of the fall of 8·31in. at Lluest Wen Reservoir. No such reason could be discovered and the reading has therefore been accepted. The rainfall records of this country contain only five previous examples of daily falls (9h. to 9h.) exceeding 8in. They are given in the table below, and it will be seen that three of them refer to the same date, June 28th, 1917. The fall of 8·31in.

County	Station	Amount	Date
		in.	
Somerset ...	Bruton (Sexey's School) ...	9·56	June 28th, 1917
,, ...	Cannington (Brymore House)	9·40	August 18th, 1924
,, ...	Bruton (King's School) ...	8·48	June 28th, 1917
,, ...	Aisholt (Timbercombe) ...	8·39	June 28th, 1917
Inverness ...	Loch Quoich (Kinlochquoich)	8·20	Oct. 11th, 1916
Cumberland	Borrowdale (Seathwaite) ...	8·03	Nov. 12th, 1897

on November 11th, 1929, has been exceeded, therefore, on only two previous rain-days. Both these occasions were " summer " rains, and the amounts shown in the table were measured at stations whose average annual fall is from 30 to 35in. The average annual fall at Lluest Wen Reservoir is about 88in. The fall of 8·31in. on November 11th, 1929, is therefore a record " winter " rain and also a record for the " wet " stations.

The gauge at Lluest Wen Reservoir was only set up in 1915, but other gauges have been in operation at the works in the upper Rhondda-fach valley since 1888. The previous largest values recorded there in one day are :—

1928 February 5th ...	4·10in.	1913 April 27th ...	4·40in.
1920 November 15th ...	4·12in.	1891 April 30th ..	4·26in.

The general meteorological conditions associated with the storm of November 11th were discussed in the *Meteorological Magazine*, 1929, pp. 249-52. It should be noted, however, that so far as the Rhondda Valleys were concerned the rainfall was steady and persistent, and no comments of abnormal intensities, so typical of the passage of a " cold front," were noted.* There is definite evidence that the rainfall ceased at 3 a.m. on the 12th, so that the whole of the rain can be credited to 18 hours. Comparing the effect of the rain in the area where over 8in. fell, with that noted after the Cannington storm of August 18th, 1924,† there is no doubt that the greatest intensity on November 11th was appreciably less than an inch an hour and probably the intensity hardly exceeded half-an-inch an hour. Recording rain-gauges were in operation at Swansea, 19 miles to the west-south-west of Lluest Wen Reservoir, and at Cray Reservoir, 13 miles to the north-north-west. On the chart for Swansea there is some indication of a slight increase in the intensity of rainfall after 8 p.m. on the 11th, but at Cray Reservoir the rain was practically uniform throughout the whole time. The amounts for successive hours at these two stations are set out below :—

RAINFALL DURING SUCCESSIVE HOURS ON NOVEMBER 11TH, 1929.

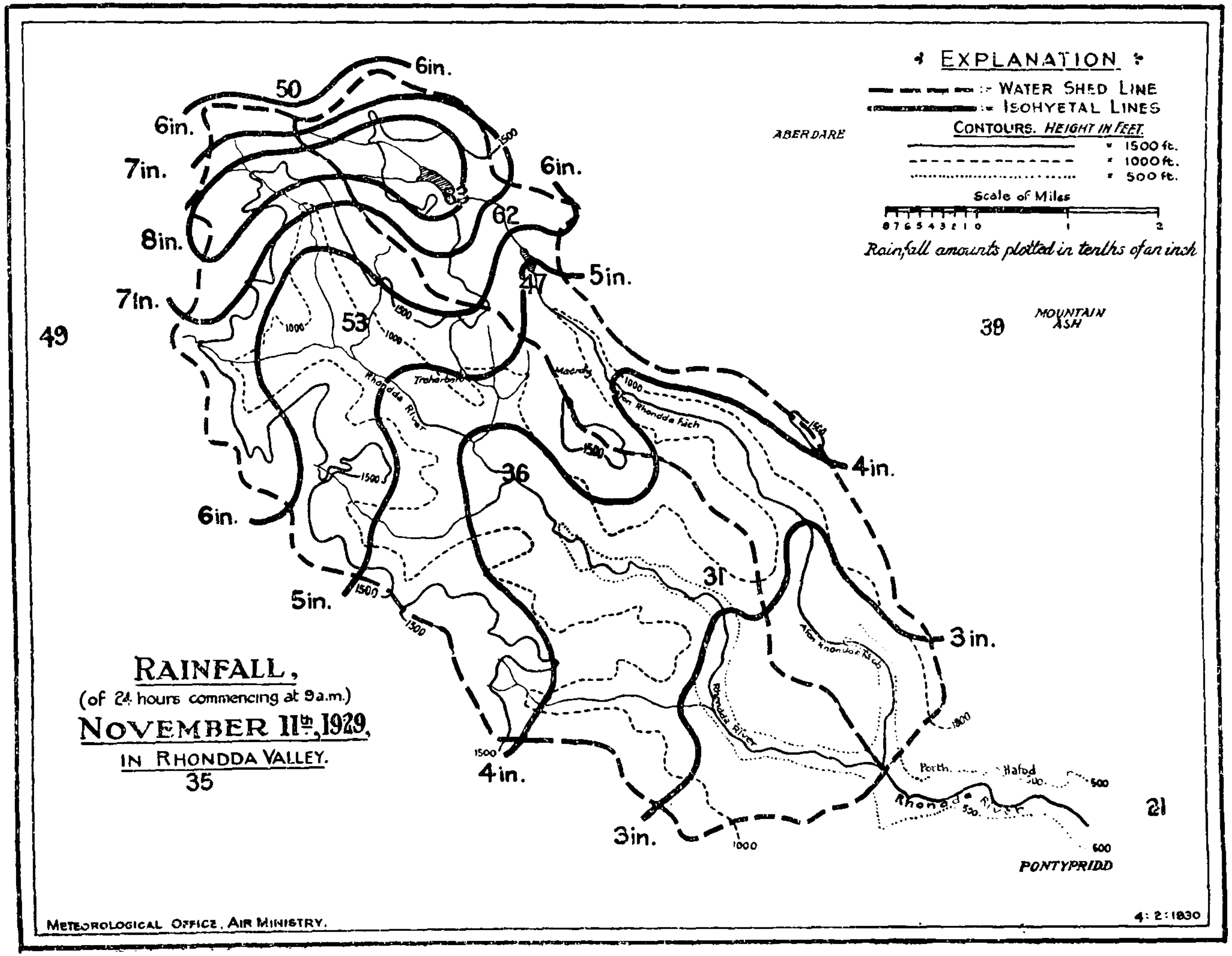
For the hour ending	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	24h.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Cray Reservoir	·22	·23	·21	·28	·24	·18	·18	·27	·28	·19	·20	·20	·19	·17	·20
Swansea (Morriston Park)	·08	·25	·24	·20	·19	·10	·11	·11	·07	·05	·03	·19	·25	·22	·08

At Cannington, on August 18th, 1924, 8 inches of rain and hail

---

* From the Article by Mr. Absalom in the *Meteorological Magazine* for December, 1929, under the title of the Storm of November 11—12th, it is apparent that the " cold front " crossed the Rhondda Valley about 22h. on the 11th. It will be interesting to know whether any autographic records which are not yet available throw any light on the question whether the orographical effect in the Rhondda Valley was sufficient to mask the variation of intensity due to the passage of the cold front. An alternative explanation may be that the rains of the Rhondda Valley were caused by some local disturbance subsidiary to the main depression.

†See the *Meteorological Magazine*, 1924, p. 187 and p. 205.


EXPLANATION
:- WATER SHED LINE
:- ISOHYETAL LINES
CONTOURS. HEIGHT IN FEET.
1500 ft.
1000 ft.
500 ft.
Scale of Miles
8 7 6 5 4 3 2 1 0 1 2
Rainfall amounts plotted in tenths of an inch
ABERDARE
MOUNTAIN ASH
PONTYPRIDD
RAINFALL,
(of 24 hours commencing at 9a.m.)
NOVEMBER 11th, 1929,
IN RHONDDA VALLEY.
6in.
7in.
8in.
5in.
4in.
3in.
50
62
47
53
49
39
36
31
35
21
Treherbert
Maerdy
Rhondda River
Rhondda Fach
Afon Rhondda Fach
Porth
Hafod
1500
1000
500
Meteorological Office, Air Ministry.
4:2:1930

fell in 5 hours, so that the rainfall was nearly four times as intense as that of November 11th. The former rain was therefore associated with ascending currents of a much greater vertical velocity than prevailed during the cyclonic rain in the later case. At Cray Reservoir, 15 miles to the north-north-west, the water rose 5 feet in 10 hours on the 11th, and this rise in the reservoir corresponds to 2 inches of water over the whole catchment area of 2,600 acres (4 sq. miles) in 10 hours.

The areas in the Rhondda Valleys covered by rainfalls exceeding certain specified amounts are set out below :—

more than 8in.	2 sq. miles	more than 4in.	21 sq. miles
,, 7in.	5 ,,	,, 3in.	32 ,,
,, 6in.	9 ,,	,, 2in.	37·5 ,,
,, 5in.	14 ,,		

These estimates correspond fairly closely to those made in the case of the Cannington storm of August 18th, 1924, when the corresponding values were 3, 5, 7. 10, 13, 27 and 47 sq. miles.* As already mentioned there was an important difference, however, for on August 18th, 1924, the bulk of the rain fell in 5 hours, while on November 11th, 1929, the rain lasted 18 hours.

The general average annual rainfall over the two areas draining to Porth is set out below, together with estimates of the general rainfall over the area for the rainfall days November 11th and November 18th and 19th.

Catchment area	Area	General rainfall		
		Average annual	Nov. 11	Nov. 18 and 19
	sq. miles	in.	in.	in.
Rhondda-fach River ...	12·0	82	4·8	6·6
Rhondda River	25·5	85	4·7	6·8
Rhondda Valley above Porth ...	37·5	84	4·7	6·7

If it be assumed that the only loss from the whole Rhondda Valleys is that due to evaporation, and that the evaporation is 15in. a year, then the mean flow at Porth would be of the order of 103 million gallons per day. The flow would, of course, be greater in winter and less in summer. The total volume of rain over the Rhondda Valleys on November 11th is computed to be 2,570 million gallons, of which the volumes in the two valleys were about 830 and 1,740 million gallons respectively. The bulk of this rain fell in 18 hours. The evaporation at this time of the year is small, and as there was fairly heavy rain on each day from November 5th to 10th, practically the whole of this volume of rain would have to flow past Porth. Following 6 days with very litle rain there was on November 18th and 19th a general rainfall over the Rhondda Valleys above Porth of 6·7in., of which about 60 per cent., or 4·0in., fell during the 24 hours ending at 4 p.m. on the 19th. This corresponds to about 2,200 million gallons of rain in 24 hours.

---

*_British Rainfall_, 1924, p. 246.

Flooding at Porth and Hafod has occurred repeatedly in earlier years, but never with such severity as in November, 1929. The last occasion on which very severe damage occurred was July, 1911. The hillsides are generally steep and bare, so that the run-off is rapid and the river rises and falls quickly. At Hafod, the river rose 2ft. in 1½ hours, with a total rise of 10ft. on the 11th, and subsided soon after the rain ceased. Severe flooding occurred on the afternoon of the 11th, and on the four successive Mondays, November 18th, 25th, and December 2nd and 9th, when additional heavy rains fell on saturated ground. At Treherbert (Tynywaun) the rainfall from 4 p.m. on November 18th to 4 p.m. on the 19th amounted to 5·71in. In the upper Rhondda Valleys the subsequent heavy rains credited to the rainfall days were:—November 24th and 25th, nearly 4in.; December 1st and 2nd nearly 3in.; December 6th, 7th and 8th nearly 5in. On November 11th some 625 houses were known to be flooded, while during the second flood the water entered over 700 houses. The general level on the second occasion was similar to that on the 11th.

The area has the disadvantage that subsidences over the coal measures are common. Thus bridges which were originally erected clear of the river in flood, now obstruct the flow. At Porth, a bridge which, when built in 1897 was some 8ft. above the normal level of the river, now stands within a couple of feet. Similarly many houses which previously were clear of floods have subsided so that now they are in danger of flooding. Near Hafod, parts of the district have subsided 23ft. through colliery workings since 1875.

I am indebted to Mr. Octavius Thomas and Mr. H. E. Maltby, the Water Engineers at Rhondda and Pontypridd, for the facilities they kindly afforded me to inspect the raingauges under their control, and to the Surveyor and Medical Officer of Health at Rhondda for many of the facts incorporated in this report.

OFFICIAL PUBLICATIONS

The following publications have recently been issued.

GEOPHYSICAL MEMOIRS.

No. 48. *The Meteorological Results of Journeys in the southern Sahara,* 1922 *and* 1927, made by F. R. Rodd, F.R.G.S., discussed by C. E. P. Brooks, D.Sc., and S. T. A. Mirrlees, M.A. (M.O. 307h.)

In 1922 Mr. F. R. Rodd visited the region between Nigeria and Aïr in the southern Sahara; in 1927 the outward journey was made over approximately the same route as before, but the return journey was westward from Aïr to the Niger near Timbuctoo.

Meteorological observations were made regularly during both expeditions and over much of the area these are the first observations available. In addition, between May and September, 1927, several autographic records of pressure and temperature were obtained. The temperature records are especially interesting for the light which they throw on the conditions under which rain falls in a great desert. On fine days the temperature rises steadily to a maximum about 3 p.m., to fall gradually during the late afternoon. On other days the temperature rises until about noon, when it falls suddenly by ten to twenty degrees, while at the same time a " tornado " brings a sudden shift of wind and frequently a storm of rain.

The high day temperatures are sometimes associated with very low humidities, but the daily range of temperature may be so great that dew forms at night, and frost is not unknown.

The winds are discussed in detail, and the structure of the south-west monsoon in the southern Sahara is also analysed by means of observations of cloud motion. Observations of visibility, mirage and other phenomena are discussed, and in an appendix the daily meteorological journal is given in full.

The Dines Balloon Meteorograph and the method of using it. By L. H. G. Dines, M.A. (M.O., 321.)

The pamphlet describes in detail a form of very light meteorograph which has been used by the Meteorological Office for many years in connexion with observations of the upper atmosphere made in Great Britain by means of small free balloons. Full instructions based on the experience gained, are given covering the whole process of making such soundings. Various pieces of auxiliary apparatus are described, which have been developed in connexion with the work.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, February 19th, at 49, Cromwell Road, South Kensington, Mr. R. G. K. Lempfert, M.A., F.Inst.P., President, in the Chair.

Dr. G. C. Simpson, C.B., F.R.S.—The Distribution of Terrestrial Radiation.

(*a*) The geographical distribution of incoming and outgoing radiation during January and July is determined and exhibited on maps.

(*b*) The incoming and outgoing radiations for each 10° zone of latitude are calculated for each month of the year.

(*c*) The result indicates great uniformity in the intensity of the outgoing terrestrial radiation, both in time and space, and that except for small uncertain irregularities the total outgoing radiation from the earth as a whole just balances the incoming solar radiation at all periods of the year.

C. K. M. Douglas, B.A.—The Cyclonic Depressions of November 16th and 23rd, 1928.

Autographic records were reproduced showing the conditions close to the centres of these two intense cyclones. These showed that in both cases the first cold front soon advanced beyond the trough line of the cyclone. This happens with nearly all intense cyclones, owing to the fact that the gradient wind behind the cold front is much greater than the rate of travel of the cyclone itself, even when this is large. It was found that the speed of advance of these cyclones was greater than that of the general current in which they travelled. This "excess velocity" is characteristic of systems with warm sectors.

Correspondence

To the Editor, *The Meteorological Magazine.*

Thunderbolt in southern New Zealand

A single thunderbolt of unusual violence was reported on January 20th at Stewart Island, at the southern extremity of New Zealand. The thunderbolt flashed down the valley on Half Moon Bay and struck a small steamer tied to the wharf.

According to the newspaper account, "the thunderbolt tore three feet from the head of the foremast, the timber reaching the sea astern of the vessel. The ship's lamps were broken, a steel wire cable was burned through, the front of the wheel house was splintered, and twelve feet of heavy timber was shattered along the port bow. The ship's compass was rendered useless, being 33° from true. . . . The damage was not confined to the steamer. In Jensen's store many articles were thrown from the shelves, while a window was broken in a house 200 yards from the water front. At Lee Bay, three miles distant, a telegraph fuse was shattered as by gelignite, the copper being melted into the porcelain, and pieces thrown 7 feet."

The trough of an intense cyclone was passing over southern New Zealand on the afternoon this phenomenal lightning occurred. Although rain fell during the morning there was no rain for some time either before or after the bolt of lightning caused such various forms of damage.

ANDREW THOMSON.

Meteorological Office, Wellington, New Zealand. January 27th, 1930.

Waterspouts in British Waters

In the *Meteorological Magazine* for November, 1929, Mr. J. Crichton gave details of 18 waterspouts observed at various times in the areas around the British Isles during the period 1920-8, both years inclusive. We have examined the synoptic charts relevant to these 18 occurrences and the results of that survey, very briefly stated, may not lack in interest. Of the 18 cases no less than 13 were associated with very slack pressure gradient and the remaining 5 with moderate pressure gradient. No single case, it will be noted, occurred with steep pressure gradient. Again, analysing the maps according to Norwegian "front theory," there were 15 of the 18 cases in which there was no suspicion of a front occurring at or near the place of occurrence of the waterspout, the remaining 3 cases being marked by occlusions. Further, 11 of the 18 cases were accompanied by thunderstorms in the vicinity.

It would appear, therefore, that waterspouts, at least these in British waters, are in the main concomitant with quiet thundery conditions, and that the above does not support the view quoted by Mr. Crichton that "waterspouts occur under conditions present during or simulating those of a line squall."

W. H. Pick.
F. E. Coles.

33, *Brunswick Square, London, W.C.*1. *December* 23*rd*, 1929.

The note on "Frequency of Waterspouts in British Waters" arose directly as a result of the Meteorological Discussion opened by Mr. Giblett* on "Mechanism of Waterspouts and Tornadoes." While refraining in the note from entering into details as to the conditions present during any of the waterspouts mentioned, I should just like to comment here that the view "waterspouts occur under conditions present or simulating those of a line squall" does not necessarily involve that on a synoptic chart representing surface conditions either there should be a steep gradient or a well-marked front. The waterspout requires instability to be present, and this frequently can only be determined by upper air observations. With this in view a re-examination of the charts might reveal such conditions, the past history of the air currents disclosing satisfactory clues. The slack gradients mentioned in the note by W. H. Pick and F. E. Coles perhaps refer to a type of gradient characterised by instability.

J. Crichton.

The Influence of explosive Volcanic Eruptions on the subsequent pressure distribution over western Europe

The article by Dr. Brooks and Miss Hunt on the above subject on page 226 of the *Meteorological Magazine* for November, 1929, raises several questions as to the validity of such a use of statistics for the calculation of how likely such a distribution of figures might arise by chance.

In the first place with so few cases, dividing the standard

---

*See *Meteorological Magazine*, 64, 1929, p. 63.

deviation by the square root of the number of cases less 1 (which seems to have been used in this paper) is not valid, but "Student's" tables (*Biometrica*, 1908, VI, 1-25; 1917, XI, 414-417) should be used and they would give for the probability of the Stykkisholm pressure for the 3rd quarter odds of 62 : 1 (as against 200 : 1 in the paper) and similarly with the 14 cases in the 3rd and 4th quarters 110 : 1 (as against 200 : 1).

Now these figures were not originally taken by chance (nor I think from *a priori* reasoning), but presumably because it was noticed that some eruptions were followed by certain types of weather and corresponding variations in the atmospheric circulation. Any other changes in pressure distribution whether abnormal types or variations in the magnitude of the normal gradients, or in magnetic or electrical phenomena in any part of the globe, might also have been taken had they coincided with those original eruptions so an allowance should be made for the number of these other possible trials that did not materialize when calculating the odds (which is impossible in practice). As regards time this was done by allowing for the fact that the figures for 10 quarters were considered, and so reducing the odds from 200 down to 20 : 1.

These difficulties are inherent in all similar statistical examinations unless the effect was predicted originally and then compared with the actual result; and, of course, in the present series the three explosions which were not originally employed by Defant are also quite valid, but only if used on Defant's original system and not on another which is now found to bring all into line better.

The fact that the biggest ash eruptions (Krakatoa and St. Vincent—St. Maria) gave the greatest deficits of Stykkisholm pressure in the following December and March quarters supports the hypothesis; on the other hand, had the December quarter for Krakatoa been positive it could equally well have been explained as the immediate rise to be followed afterwards by a fall.

GEOFFREY S. PHILLPOTTS.

Oakfield, Foxrock, Co. Dublin. January 22nd. 1930.

Percolation at Grayshott

Observations of percolation to a depth of 3 feet in natural soil at Grayshott have now ceased owing to the gauge having fallen into disrepair. The record extends from January, 1904, to December, 1929, giving a period of 26 years. The height above sea-level is 661 feet and the soil in the neighbourhood is very light and sandy, the vegetation being chiefly heather, gorse, fir, whortleberry and bracken. The mean annual rainfall for this period is 36·94 inches, and the corresponding run-off 23·84 inches. This gives a percentage percolation of 64·53.

The highest annual percentage was 75·7 in 1923 and the lowest 32·0 in 1921. In this latter year only 5·69 inches percolated to a depth of 3 feet. The longest period in which no water percolated was from May 23rd, 1921, to January 1st, 1922, which is 223 days. By employing annual values of rainfall and run off, a correlation coefficient of + 0·993 was obtained.

Evaporation cannot be determined by using monthly values of rainfall and percolation, as in summer, evaporation exceeds the rainfall and in winter, the percolation is sometimes greater than the rainfall. This latter effect is due to the water already present in the soil being carried through, and sometimes to a large run off being measured at the beginning of a month as the result of heavy rain at the end of the previous month. The greatest evaporation in any one year of the period concerned is 15·96 inches in 1906 and the smallest 9·23 inches in 1923. The mean value for 26 years is 13·10 inches. Unfortunately no evaporimeter observations have been made at Grayshott for comparison.

S. E. Ashmore.

Windwhistle Cottage, Grayshott, Hindhead, Surrey. January 5th, 1930.

Range of Visibility in a Fog

I had an opportunity this morning of making similar observations to those mentioned by Col. Gold in his letter in your February issue. The city was enveloped in a thick fog, though the light was fairly good, with visibility in the centre of the city between 40 and 120 yards (the fog was very patchy as it usually is here). I made two or three observations of the relative visibility of lights and the standards on which they are hung, and in all cases I found that the light could be seen at least twice as far away as the standard—in one case it was considerably further. My observations were made on electric lights about 9 a.m. Though I have never made detailed observations of this before, from general experience of fogs here I should say that this difference is quite usual here.

H. E. Ellinger.

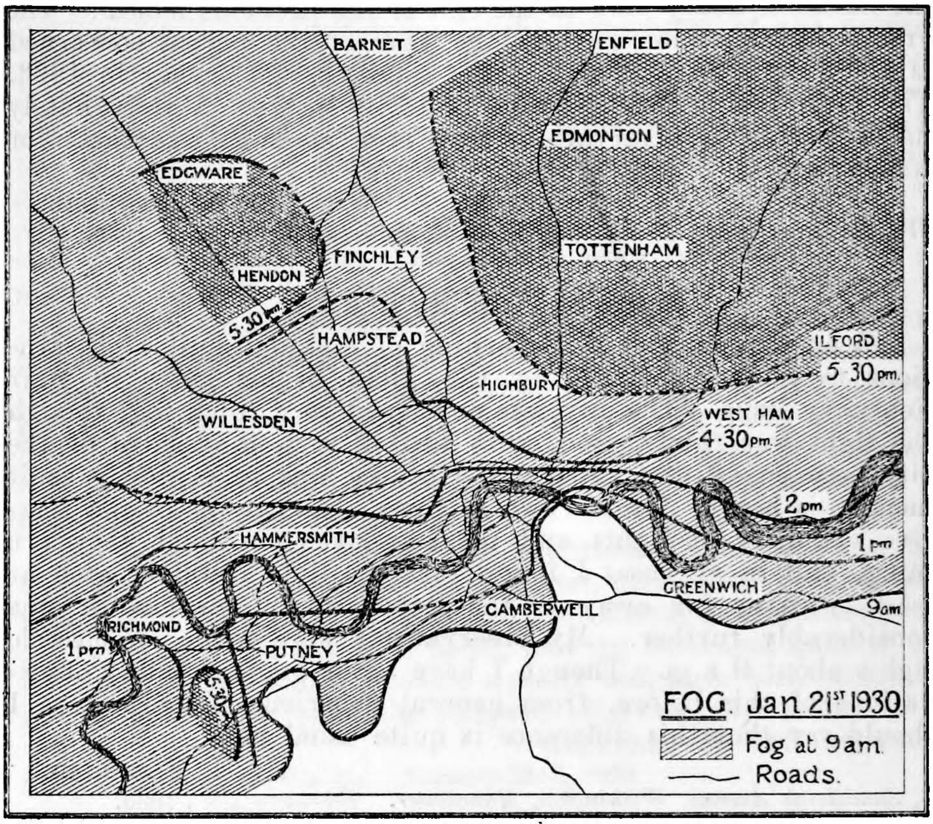
7, *Sandileigh Avenue, Withington, Manchester. February 21st*, 1930.

NOTES AND QUERIES

Fog of January 21st, 1930

On two previous occasions I have investigated the distribution of fog over the London area, and the occurrence of a dense fog on January 21st, 1930, offered a third opportunity to obtain further data. On that date fog conditions were much more widespread than on the other two occasions; the fog which affected the London area was only a small part of a foggy belt whose northern edge lay east and west somewhere north of Luton and whose southern edge seems to have coincided roughly with the Thames.

The results obtained from this investigation are different from the others in that, while little light was thrown on the onset of the fog, the stages of its disappearance were much more clearly shown. Beyond the fact that the fog set in over the eastern part of the London area much earlier than in the western districts, little information has been obtained as to the way in which it spread. In the east it had reached the river by the very early hours of the morning, while in the west it was only between 7.30 and 8 a.m. that mist became fog. The map shows the conditions at 9 a.m. The most noticeable feature is the curious wavy front which has been remarked on previously. These conditions remained almost unchanged till about 12.30 p.m., though it is just possible that before then the fog front retired a little in the neighbourhood of London Bridge, and it had certainly gone from Blackheath and eastwards. After 12.30 p.m. the fog front moved steadily northwards, losing some of its sinuosities as it did so. Its position is shown at 1 p.m., 2 p.m., 4.30 p.m., and 5.30 p.m. In the east the front was clearly defined; in most of the western areas, however, the fog gradually thinned to mist and it is more difficult to mark the front.


BARNET
ENFIELD
EDMONTON
EDGWARE
HENDON
FINCHLEY
5·30pm
HAMPSTEAD
TOTTENHAM
HIGHBURY
ILFORD
5 30pm.
WEST HAM
4·30pm.
WILLESDEN
2pm
1pm
HAMMERSMITH
GREENWICH
9am
CAMBERWELL
RICHMOND
1pm
PUTNEY
5·30
FOG. Jan 21st 1930
Fog at 9am.
Roads.

One definite result must be pointed out, namely, that in the Lea valley the fog never disappeared at all but continued on into the 22nd. On both the previous occasions the Lea valley was found to be covered with fog. On one of these occasions the fog advanced from the Lea valley over other parts of London. On this occasion the fog retired there. That fog was associated with the Lea valley on two occasions might be only a coincidence, but when this relationship occurs on a third occasion it is more than a coincidence, it appears to be a habit. The Lea valley seems indeed to be the villain of the piece.

J. FAIRGRIEVE.

Floods in Southern France

A series of disastrous floods occurred in southeastern France at the end of February and the early days of March, as a result of which enormous damage was done to property, and several hundred lives were lost. The tragedy reached its greatest intensity in the valley of the Garonne and its tributaries, especially the Tarn, but the area affected extended almost to the Rhône in the east and the Pyrenees in the south.

Few details are available as yet, but from the data given in the French *Bulletin Quotidien d'Etudes* it appears that the floods were caused by heavy rain which began on the night of February 26th-27th. By 6 p.m. on the 27th, 1·4in. had fallen at Nîmes, a short distance inland from the Gulf of Lions. On the 27th-28th heavy falls occurred in the Rhône Valley, which in the 13 hours ending at 7 a.m. amounted to 1·5in. at Marignane, and 2in. at Montelimar. On March 1st the area of the rainstorm extended westward, and nearly 3in. fell at Perpignan. These stations are all on low ground, and it is almost certain that very much heavier totals occurred on the high ground of the southern Auvergne Mountains. These mountains form the gathering ground for a number of streams, such as the rivers Lot, Aveyron and Tarn, which flow westward in deep narrow gorges and eventually find their way into the Garonne. It was in these streams, and especially the Tarn, that the most serious flooding occurred. It is reported that the town of Moissac, on the latter river near its junction with the Garonne, was almost entirely destroyed through the bursting of a dam or embankment.

An examination of the weather maps shows that throughout the period there was a deep and powerful southeasterly current blowing from the Mediterranean towards the Auvergne mountains. On February 27th a barometric depression was centred over Brittany and moved southwards to the Bay of Biscay on the 28th and the eastern Mediterranean on March 1st, while on the 2nd another depression appeared in the Bay of Biscay. At

Marignane the wind at a height of 500 metres was 40 m./sec. from ESE. on February 27th and 54 m./sec. from ESE. on March 2nd. Coming from the Mediterranean, this wind was naturally moist, and its forced ascent over the Auvergne would cause very heavy rain. It was also relatively warm for the season, and the floods were accentuated by melting of the snows.

Hurricane at the Bahamas

An account of the hurricane which passed over the Bahamas on September 25th-26th, 1929, has been received from Mr. E. J. V. Armsden of the Imperial Lighthouse Service, through the courtesy of the Mercantile Marine Department of the Board of Trade. The hurricane was centred about lat. 26° N., long. 75° W. approx. 100 miles northeast of Governors Harbour at noon on Tuesday, September 24th, and was moving west or west-northwest. The barometer in Nassau then stood at 1,018 mb. (30·05 in.), wind WNW., force 5, sky cloudy. At 3 p.m. the wind freshened from the west with overcast sky and falling barometer, and at 7 p.m. news was received that the storm was centred 150 miles northeast of Nassau and was increasing in intensity and moving westnorthwest, so that it did not seem likely then that Nassau would be affected. In the early hours of the 25th however the wind veered to the north of west at Nassau, increasing to a moderate gale with a high sea running in the harbour. This was followed by a slight backing about 1 p.m., when there were fierce gusts of hurricane force and torrential rain. At 9 p.m. the centre approached, the wind dropped to a dead calm, although a heavy confused sea continued in the harbour and the barometer stood at 948mb. (28·00 in., below which the aneroid barometers supplied do not register). " The wind came from the east at 1 a.m. increasing in gusts to full hurricane force and backing to ENE. By 2 a.m. the barometer had risen slightly, though the wind was of violence incredible . . . . The dawn broke shortly after 6 a.m. The barometer then stood at 980 mb. (28·93 in.), with wind of hurricane force from the ENE. During the forenoon the storm began to abate, and by 2 p.m. on the 26th the wind had fallen to a strong gale from the east, which continued throughout the day and following night with steadily rising barometer. By 8 a.m. on the 28th the barometer stood at 1,013 mb. (29·92 in.), and the wind had fallen to a moderate easterly breeze with overcast sky and rain. . .

The storm itself was of extreme severity, and seems to have taken a most unusual course. Instead of travelling to the west-northwest as tropical disturbances generally do in these latitudes, it appears to have travelled southwest, the centre passing over Nassau and Andros Island."

Pilot's Report of Experiences of Landing Through A Sand Devil

Flying Officer Wayte reported the following after having landed through a Sand Devil which existed over Amman aerodrome at some time between 10h. 45m. and 11h. G.M.T. on June 15th, 1929. He was so concerned with the safety of his machine that detailed notes on the devil were not practicable and, unfortunately, it was not seen by anyone else.

The aircraft dropped so violently that both pilot and passenger involuntarily left their seats and were brought up with a snatch against their safety belts. A Vèry pistol, lying in its holder on the floor of the pilot's cockpit, but not fastened down in any way, " rose " out of its place to the level of the pilot's chest and then " fell " back again into some other part of the machine, and was not found until after taxying into the sheds. The pilot is a man of small stature, so it may be assumed that the pistol " rose " about three feet. Several articles carried in a small locker just behind the pilot's head were " thrown out " and " fell " over into the observer's cockpit. Dust and small bits of rubbish lying on the floor of the pilot's cockpit " rose " in a cloud around the pilot's body and head.

The reference to " rising " and " falling " of these various things are in inverted commas since it seems likely that the movements being relative, what actually happened was that the whole aircraft itself fell away from the loose articles leaving them suspended for a fraction of time before either genuinely falling back into the machine, or/and being caught up by the aircraft again when it was lifted slightly by the use of the controls to counteract the effect of the " bump." There is a remote chance that the cockpit dust, &c., was lifted by the devil itself, the engine was throttled for landing, of course.

[The most remarkable point about this account, for which we thank Mr. J. Durward, was that the aircraft not only " fell " but was forced downwards with an acceleration exceeding that due to gravity, otherwise of course the articles referred to could not have left the floor.—Ed., *M.M.*]

Changes in the " Daily Weather Report "

At an International Conference of Directors of Meteorological Services held in Copenhagen during September, 1929, the codes used in the international exchange of meteorological information were drastically revised, and in some particulars, especially in the case of cloud, entirely new codes embodying new information were drawn up. The new codes were to be brought into use by most of the meteorological services of Europe on March 1st, and this necessitated modifying the information published in the *Daily Weather Report*, the columns used in the former *Report* being no longer suitable.

The opportunity afforded by this change has been taken to add a chart of the Northern Hemisphere to the British Section, as it has now become possible through the improvement in international co-operation to prepare such a chart daily. As this new chart contains much of the information shown on the chart of western Europe which was formerly published, it has been found possible to replace the latter by a chart on the same scale but limited to the area of the British Isles. It has, however, been found necessary to omit the three inset maps and one or two of the less important tables. In order to minimise the loss of the isallobar chart, the barometric tendency is being entered on the chart for the British Isles.

It is regretted that the change has necessitated increasing the size of the *Report*, as this may make its exhibition in the frames designed for the old chart difficult. It is felt, however, that by judicious folding of the *Report*, so that the information considered of least importance is not exhibited, the chart can be made to fit the old frames.

Reviews

Climate : A Handbook for Business Men, Students, aud Travellers. By C. E. P. Brooks, D.Sc. Size 8½ x 5½in., pp. 199. *Illus.* London, Ernest Benn Ltd., 1929. 10s. 6d. net.

Having in his previous works fascinated us by his speculations on the character of climate before its elements were as carefully studied as they are by modern meteorologists, and on the way in which it has evolved to its present state, Dr. Brooks now sets out to show us the climate of the world as it exists to-day. His position as Superintendent of the General Climatology Division of the Meteorological Office has given him a unique opportunity for the collection of climatic data from all parts of the globe and in this volume he places much of this material at the disposal of the general reader, together with his own valuable interpretation of the facts given and of the still greater mass of data in his possession.

The arrangement of the book is on the lines of climatic regions subdivided by political or continental boundaries. Thus the seven chapter headings are "The North Temperate Regions," "Mediterranean Climates," "North Tropical Climates," "Equatorial Climates," "Sub-tropical Climates of the Southern Hemisphere," and "The Polar Regions." The use of the term "sub-tropical" can hardly be regarded as satisfactory, for although Dr. Brooks is content to classify the climate of the Azores and the Canary Islands as "north tropical," that of Madagascar is called "sub-tropical." The method of subdivision of the chapters also results in the climate of Arabia being classified as "Mediterranean" while that of the Californian Valley is " north temperate "; and the reader is left the choice of either " sub-tropical " or " temperate " as a description of the climate of central Chile. Some, too, may disagree with the author's endorsement of Köppen's use of the term " Boreal " to describe the climate of central Canada and Siberia.

The separate sections of each chapter are followed by tables clearly setting out climatic data for ten stations in each region considered. For each station are given its latitude, longitude and height above sea level, and also the period over which the observations there have extended. Then follow mean monthly and mean annual values for temperature and precipitation, mean daily range of temperature for January and July, and mean values of relative humidity and cloud amount for the same two months. The highest and lowest temperatures ever recorded at each station are then given, and also the mean annual values of the daily maxima and minima. Finally the average number of days in the year on which rain and snow have fallen, and on which thunder has been heard are recorded. Thus this book provides for over two hundred stations a more complete summary of authentic climatic data than can be obtained in any other published volume.

The tables and accompanying climatic descriptions will give the business men and travellers for whom the book has been written all that they may reasonably expect of such a work, but although the students, who make up the remaining third of the audience to which the author and publishers address themselves, will find the tables of inestimable value, we feel that they will perhaps be a little disappointed in the work as a whole. They might quite reasonably expect a fuller explanatory treatment of some phenomena than is here given, and would certainly welcome a more generous allowance of maps and diagrams. There are only three of the latter, two being the necessary if somewhat familiar isobar maps of the world for January and July, and the third a graphical representation of mean monthly temperature and rainfall at Kew such as is now commonly drawn by lower form pupils in most secondary schools. It is explained in the introduction that these limitations are the result of endeavouring to keep the book small in bulk and low in price, but they certainly detract seriously from its value as a book for students.

It is to be hoped that in the later editions which will certainly be called for, a few of these defects may be remedied. For example, a simple map for each of the chapters showing the location of all the stations referred to would be much better than quoting the latitude and longitude of these often quite unfamiliar places, especially as in a few cases, such as that of Calabozo (p. 141), the misprinting of one of the co-ordinates makes the text difficult to follow. Similarly the several occasions on which the text says east or easterly instead of west or westerly would have been less disturbing to the student if an accompanying map or diagram had made it clear that these were simply terminological inexactitudes.

Many will wish that Dr. Brooks had allowed himself more space to deal with the subject of descending winds and their climatic effects. For example an account is given of the warming effects of the chinook and the föhn, followed some pages later by reference to the chilling effects of the mistral and the bora, without the significant cause of the difference between the two cases being even hinted at. The student will probably find it still more puzzling to understand why the wind which blows from the mountains of Sinai into the Gulf of Akaba has a cooling effect, while a little later on the high temperatures experienced on the south coast of Asia Minor are ascribed to winds descending from the mountains. Finally many will find it very difficult to believe without further explanation that the winds descending from the ice plateau of Greenland which has a mean winter temperature of probably minus 60° (p. 183) sometimes cause the temperature to rise 50° or more in a few hours at places on the coast which have a mean temperature at the same season of about zero.

The effect of cold currents on the climate of west coast regions in middle latitudes might also have been rather more fully treated. For example, it is explained that high relative humidity and abnormal fogginess are experienced regularly where a cold current washes a warm land area, and this is illustrated by references to California, Rio Doro and southwest Africa. But although there is a reference to high humidity in the corresponding region of Peru there is no mention of fogs, while in the case of Western Australia not only does there appear to be no fogs but we are told that humidity is only moderate. We feel that the student will expect some explanation of these seeming anomalies. He will also be anxious to know why it is that in Germany and France hail is associated with thunderstorms (p. 27), while in Britain hail is most frequent where thunderstorms are least common (p. 20), but the book does not enlighten him on this point. We are also given a fairly full and interesting account of the origin of the tornadoes of the American prairies, but the modern theories of the origin of the cyclones of the North Atlantic which mean so much more to most English readers receive no mention.

In conclusion, however, we are sure that students will welcome this handy volume as a notable addition to the existing literature of climatology, which incidentally is admirably summarised in the bibliographies attached to each chapter of the book, but they will also look forward to the time when Dr. Brooks will give us in a much larger work a more comprehensive treatment of the whole subject.

C. B. THURSTON.

Sea-Surface Temperatures on some Steamer Routes in the Malay Archipelago. By Dr. H. P. Berlage, Jr. Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verh. No. 21, 1928.

Investigations based on sea-surface temperatures have been rare up to the present time, the steadily accumulating data having been utilised chiefly for the formation of monthly averages for the main oceanic areas. In the above paper Dr. Berlage, Jr., gives the results of an analysis of the temperatures observed on Dutch steamships on five routes in the South China and East Indian Seas. The observations were organised by Dr. Braak on three of the routes in 1913, the remaining two beginning in 1922 and 1925 respectively. The temperatures were read with tested thermometers, the usual canvas-bucket method for obtaining the sample being employed. The number of observations range from 13,929 on the Singapore to Pontianak (West Borneo) route to 587 on the Menado (North Celebes) to Ternate (Moluccas) route.

Since 1921 the observations have been taken every two hours, day and night, the previous interval being four hours. The fixed times of arrival and departure would introduce systematic errors in the mean monthly temperatures if these were uncorrected for diurnal variation. The diurnal variation has therefore been worked out for the middle part of the routes and the mean monthly values corrected accordingly. Data are however insufficient to do this completely except in the case of the route Singapore to Pontianak, but a probable correction is applied where necessary. On the route mentioned the mean daily range for the year amounts to 0.70°C., the mean monthly range being greatest during the changes of the monsoon in April (1·08°C.) and November (0·92°C.), when wind and current speeds are low, and least in August (0·40°C.). On the same route temperature is highest about 13h. and lowest about 3h. Detailed tables of mean monthly temperatures for each year of observation are given for all routes, each half-degree of latitude or longitude being separately computed. Tables of monthly deviations from the average are also given. The mean annual ranges of temperature on the better observed routes in general slightly exceed 2°C. and on all routes temperature maxima occur in the months of the change of the monsoon, with minima during the steady monsoons. The relation between the temperatures of the east and west monsoon periods however varies on different routes.

For the mid-areas of the chief routes the mean deviations are smoothed over consecutive six-monthly periods and are given in graphical form. The curves show variations which it is hoped will be of assistance in connexion with an inquiry which is being made as to the possibility of long-range monsoon forecasting in the East Indies. E. W. Barlow.

Anales del Observatorio Nacional de San Bartolome en los Andes Colombianos. Observaciones meteorologicas de 1927. Size 13½ × 9½in., pp. xiii + 78. Bogota, 1929.

The observatory at Bogota was inaugurated in 1922, and its first publication was reviewed in this magazine in 1925.* Since then the lag between year-end and publication of the results has been gradually reduced. The present volume deals mainly with the observations at Bogota, which have been carried on as in previous years, but there are also included summaries of observations at nine secondary stations and a description of geophysical methods in prospecting. We note with pleasure the continued progress of the Colombian meteorological service under the direction of Father Sarasola.

Books Received

Uber den Einfluss meteorologischer Faktoren auf die Potentialgefälle in Davos. By M. Bider (Verh. Schweiz. Natur. Gesellschaft Lausanne, 1928. Part II, pp. 149-52).

Obituary

Dr. Felix M. Exner.—We regret to learn of the death of Hofrat Prof. Dr. Felix M. Exner on February 7th, 1930, at the early age of 54. Dr. Exner was born at Vienna on August 23rd, 1876. After taking the degree of Doctor of Philosophy at Vienna in 1900, he served for ten years as an assistant at the Zentralanstalt. From 1910 to 1916 he was Professor of Cosmical Physics at the University of Innsbruck, and from 1917 until his death Professor of Physics of the Earth at the University of Vienna and Director of the Zentralanstalt für Meteorologie und Geodynamik.

Dr. Exner is perhaps best known to students for his text-book "Dynamische Meteorologie," of which the first edition appeared in 1917 and the second in 1925, and for his association with J. M. Pernter in preparing the second edition of "Meteorologische Optik." He also collected the invaluable series of monthly data for European stations which are included in the volume of "World Weather Records," published in 1927 as Volume 79 of the *Smithsonian Miscellaneous Collections.* His numerous papers deal especially with the dynamics of the atmosphere, including the distribution of pressure anomalies and other problems of the atmospheric circulation, but he wrote at

---

**Meteorological Magazine* 60 (1925), p. 172.

one time or another on almost every branch of meteorology, and even went outside the science, as in his studies of dune formation.

We regret to learn of the death on January 7th, 1930, of Prof. Henry J. Cox, Principal Meteorologist, U.S. Weather Bureau and Councillor, American Meteorological Society since 1919.

News in Brief

The Meteorological Office Staff held their eleventh Annual Soirée at the Portman Rooms on February 7th. The function which was well attended by the past and present staff and their friends, consisted of dancing, concert items and community singing. The staff appreciate the services of the artistes who voluntarily helped to make the evening a success.

The Ninth Annual Dinner of the Staff of the Meteorological Office, Shoeburyness, was held at the Queen's Hotel, Westcliff, on Saturday, February 15th. The guest was Mr. D. Brunt, Superintendent of Army Services, and past members of the staff now serving at other stations were present. The customary entertainment consisting of original topical items followed the dinner.

Errata

January, 1930, page 278, line 43, *for* " 77°F. on the 28th," *read* " 77°F. on the 29th."

February, 1930, page 22, last two lines, *for* " *Jahrbuch*, 1926," *read* " *Jahrbuch*, 1927," and *for* " Bremen, 1928," read " Bremen, 1929."

The Weather of February, 1930

The weather of the month was generally dry and cold, the mean temperature being below normal by 1·0°F. at Kew and by 5·6°F. at Valentia, while at several places in Scotland and northern England the rainfall was less than 20 per cent. of the normal. During the first few days depressions passed across the southern part of the country giving unsettled conditions generally and moderate rainfall in south England and Ireland. By the 6th and 7th these depressions had moved further south and east, and the rain area had withdrawn to the eastern districts, while an anticyclone situated to the north of Iceland on the 5th moved slowly southsoutheast and was centred over Scotland on the 8th. Among the larger rain measurements at this time may be mentioned 1·21in. at Swingfield, Kent, on the 6th, and 0·98in. at Hartland, Devon, on the 3rd; snow occurred locally in the eastern districts on the 6th and 7th. In the west the 6th, 7th and 8th were all sunny days, *e.g.*, at Mallarany 8·0hrs. were recorded on the 6th and 8·3hrs. on the 7th. From this time onwards mainly anticylonic conditions persisted, apart from a temporary break on the 14th and 15th, when a trough of low pressure crossed the country. This was immediately followed by another anticyclone. On the 14th temperature rose generally to 50°F., but in the rear of the trough there were cold northerly winds, and snow fell in most parts. Slight snow was also experienced over most of the country on the 16th and 17th. During the anticyclonic periods from the 7th-13th and 16th-24th the minimum temperature readings were low, those in the screen falling below 20°F. on several days, while on the ground, 9°F. was recorded at Rhayader on the 17th, 11°F. at Aspatria on the 10th. The diurnal range was also usually small, day temperatures being frequently below normal. Much cloud occurred during this period in the east, except on occasional days among which the 9th, 16th and 17th may be noted, when between 8 and 9 hrs. bright sunshine occurred over the country generally, 9·2hrs. being registered at Rhayader on the 16th. A depression off southeast Ireland on the 24th moved slowly southeast and slight rain or snow was experienced generally on the 24th, 25th and 26th. In south Ireland the amounts were heavier, 1·13in. being recorded at Waterford on the 25th. On the 27th and 28th the conditions again became anticyclonic and temperature rose above 50°F., reaching 55°F. at Kilmarnock and 54°F. at Dumfries and Plymouth on the 28th and Cambridge on the 27th, and there was much sunshine at many places, *e.g.*, 9·3hrs. at Plymouth, 9·1hrs. at Aspatria on the 28th and 8·9hrs. at Inverness on the 27th. Mist and fog occurred in the mornings and evenings. The distribution of sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs).
Stornoway	75	+17	Liverpool	41	—27
Aberdeen	82	+ 9	Ross-on-Wye	44	—27
Dublin	84	+11	Falmouth	89	+ 6
Birr Castle	70	+ 3	Gorleston	69	—12
Valentia	112	+43	Kew	47	—13

Pressure was above normal over northwestern Europe and the North Atlantic, the greatest excess being 13·2mb. at Thorshavn (Faeroes) and below normal over southwestern Europe and Spitsbergen, the greatest deficit being 12·8mb. at Spitsbergen. Temperature was above normal at Spitsbergen and over Scandinavia (as much as 15°F. at Spitsbergen and 11°F. in northernmost Sweden), but below normal in southern and central Europe. Rainfall was generally deficient over the whole of western Europe but in excess at Spitsbergen.

High tides caused much damage on the west coast of France, and there were heavy floods in the department of Var on the 2nd. Following the mild weather prevailing in Switzerland snow fell heavily on the 3rd down to the level of Geneva. Heavy snow between Madrid, Barcelona and Seville on the 8th, delayed the trains and caused a railway accident. The hamlet of Villa di Mezzo in the province of Marche (east-central Italy) was overwhelmed by an avalanche from Monte Pettrano on the 22nd; more than 15 people were killed. Snow fell heavily on the mountains of Upper Piedmont, reaching a depth of over 3ft. about the 23rd. At Trieste the Bora was so strong on the 23rd that local railway traffic was interrupted. Landslips and floods were reported from Calabria and serious damage done by a tidal wave at Catanzaro about the same time. Snow fell heavily during the last days of the month in the mountain regions of Corsica and was nearly 10ft. deep in the district of Vizzavona.

Continued heavy rain during the first seven days of the month prevented railway communications between Kilosa and Dodoma (Tanganyika Territory).

Widespread rain fell in the agricultural area of South Australia between the 1st and 3rd, ranging from 1½in. to nearly 6in. Heavy rain in the southeast of Western Australia later in the month caused floods in the desert there, which stopped all railway communications.

A severe storm did much damage at Burges, Newfoundland, on the 21st, where the floods resulting from the storm were followed by severe frosts.

Temperature during the month over the United States was generally high for the time of year. A sudden cold wave accompanied by severe snowstorms swept across the eastern States about the 16th, but this was followed in a few days by a spell of exceptionally warm weather with southerly winds, extending also to Canada. A maximum temperature of 84°F. was reported from Washington, of 74°F. from New York on the 25th and of 55°F. at Toronto on the 23rd. Thunderstorms, however, occurred generally in the east in the evening of the 25th, and temperature fell rapidly. Precipitation in the United States was generally deficient for the month. Fog was experienced off the east coast from about the 20th-25th.

A severe and sudden storm was experienced at Nassau, Bahamas, on the 17th, and severe gales occurred on the North Atlantic early in the month.

The special message from Brazil states that seven anticyclones passed across the country, and that the crops are generally affected by the small and irregular rainfall during the last two months. At Rio de Janeiro pressure was 0·6mb. below normal and temperature 0·4°F. above normal.

Rainfall, February, 1930.—General Distribution

England and Wales	46	per cent of the average 1881-1915.
Scotland	32	
Ireland	28	
British Isles	39	

Rainfall: February, 1930: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	1·01	60	*Leics* .	Belvoir Castle	·50	30
Sur .	Reigate, Alvington	·94	43	*Rut* .	Ridlington	·73	...
Kent .	Tenterden, Ashenden	1·75	89	*Linc* .	Boston, Skirbeck	·70	48
,, .	Folkestone, Boro. San.	1·80	...	,, .	Lincoln	...	...
,, .	Margate, Cliftonville	1·01	73	,, .	Skegness, Marine Gdns	1·04	68
,, .	Sevenoaks, Speldhurst	1·43	...	,, .	Louth, Westgate	·94	49
Sus .	Patching Farm	1·38	62	,, .	Brigg, Wrawby St.	·28	...
,, .	Brighton, Old Steyne	1·30	64	*Notts* .	Worksop, Hodsock	·71	46
,, .	Heathfield, Barklye	1·54	65	*Derby* .	Derby, L. M. & S. Rly.	...	...
Hants .	Ventnor, Roy. Nat. Hos.	1·29	61	,, .	Buxton, Devon Hos.	·76	20
,, .	Fordingbridge, Oaklnds	·81	33	*Ches* .	Runcorn, Weston Pt.	·26	14
,, .	Ovington Rectory	·95	37	,, .	Nantwich, Dorfold Hall	·39	...
,, .	Sherborne St. John	·81	37	*Lancs* .	Manchester, Whit. Pk.	·28	15
Berks .	Wellington College	·60	32	,, .	Stonyhurst College	·41	12
,, .	Newbury, Greenham	·68	31	,, .	Southport, Hesketh Pk	·33	16
Herts .	Welwyn Garden City	·54	...	,, .	Lancaster, Strathspey	·26	...
Bucks .	High Wycombe	·91	49	*Yorks* .	Wath-upon-Dearne	·59	36
Oxf .	Oxford, Mag. College	·53	34	,, .	Bradford, Lister Pk.	1·18	50
Nor .	Pitsford, Sedgebrook	·68	41	,, .	Oughtershaw Hall	1·32	...
,, .	Oundle	·76	...	,, .	Wetherby, Ribston H.	·78	45
Beds .	Woburn, Crawley Mill	·62	42	,, .	Hull, Pearson Park	·63	38
Cam .	Cambridge, Bot. Gdns.	·53	41	,, .	Holme-on-Spalding	·45	...
Essex .	Chelmsford, CountyLab	·56	38	,, .	West Witton, Ivy Ho.	1·19	...
,, .	Lexden Hill House	·61	...	,, .	Felixkirk, Mt. St. John	1·32	78
Suff .	Hawkedon Rectory	·72	47	,, .	Pickering, Hungate	1·67	...
,, .	Haughley House	·44	...	,, .	Scarborough	1·53	91
Norf .	Norwich, Eaton	1·05	64	,, .	Middlesbrough	1·25	96
,, .	Wells, Holkham Hall	1·10	74	,, .	Baldersdale, Hury Res.	...	...
,, .	Little Dunham	1·47	91	*Durh* .	Ushaw College	1·79	113
Wilts .	Devizes, Highclere	·79	40	*Nor* .	Newcastle, Town Moor	1·69	106
,, .	Bishops Cannings	·82	39	,, .	Bellingham. Highgreen	2·03	...
Dor .	Evershot, Melbury Ho.	1·12	36	,, .	Lilburn Tower Gdns.	2·02	...
,, .	Creech Grange	·82	...	*Cumb* .	Geltsdale	·52	...
,, .	Shaftesbury, Abbey Ho.	1·18	51	,, .	Carlisle, Scaleby Hall	·35	16
Devon .	Plymouth, The Hoe	2·45	82	,, .	Borrowdale, Seathwaite	1·75	15
,, .	Polapit Tamar	1·70	53	,, .	Borrowdale, Rosthwaite	·68	...
,, .	Ashburton, Druid Ho.	...	...	,, .	Keswick, High Hill	·52	...
,, .	Cullompton	1·24	44	*Glam* .	Cardiff, Ely P. Stn.	·74	25
,, .	Sidmouth, Sidmount	1·08	43	,, .	Treherbert. Tynywaun	1·21	...
,, .	Filleigh, Castle Hill	1·51	...	*Carm* .	Carmarthen Friary	·53	14
,, .	Barnstaple. N. Dev. Ath.	1·30	48	,, .	Llanwrda	·55	13
Corn .	Redruth, Trewirgie	3·35	89	*Pemb* .	Haverfordwest, School	·59	17
,, .	Penzance, Morrab Gdn.	3·36	101	*Card* .	Aberystwyth	·36	...
,, .	St. Austell, Trevarna	1·90	49	,, .	Cardigan, County Sch.	·38	...
Soms .	Chewton Mendip	·75	22	*Brec* .	Crickhowell, Talymaes	1·00	...
,, .	Long Ashton	·55	...	*Rad* .	BirmW. W. Tyrmynydd	·88	17
,, .	Street, Millfield	..	...	*Mont* .	Lake Vyrnwy	·87	19
Glos. .	Cirencester, Gwynfa	·53	23	*Denb* .	Llangynhafal	·85	...
Here .	Ross, Birchlea	·89	44	*Mer* .	Dolgelly, Bryntirion	·79	18
,, .	Ledbury, Underdown	·68	37	*Carn* .	Llandudno	·33	16
Salop .	Church Stretton	1·04	47	,, .	Snowdon, L. Llydaw 9	1·75	...
,, .	Shifnal, Hatton Grange	·55	34	*Ang* .	Holyhead, Salt Island	·46	19
Worc .	Ombersley, Holt Lock	·41	25	,, .	Lligwy	·28	...
,, .	Blockley	·54	...	*Isle of Man*			
War .	Farnborough	·80	39		Douglas, Boro' Cem.	·70	22
,, .	Birminghm, Edgbaston	·90	53	*Guernsey*			
Leics .	Thornton Reservoir	·96	57		St. PeterP't. GrangeRd.	1·67	68

Rainfall: February, 1930: Scotland and Ireland

Co.	STATION	In.	Per-cent of Av.	Co.	STATION	In.	Per-cent of Av.
Wigt .	Stoneykirk, Ardwell Ho	...	...	*Suth* .	Loch More, Achfary...	1·91	29
,, .	Pt. William, Monreith	·36	...	*Caith* .	Wick	1·22	54
Kirk .	Carsphairn, Shiel	·57	...	*Ork* .	Pomona, Deerness	·85	28
,, .	Dumfries, Cargen	·35	9	*Shet* .	Lerwick	1·57	50
Dumf .	Eskdalemuir Obs.	·78	...	*Cork* .	Caheragh Rectory	1·21	...
Roxb .	Branxholm	·70	27	,, .	Dunmanway Rectory...	1·11	19
Selk .	Ettrick Manse	·56	...	,, .	Ballinacurra	1·36	36
Peeb .	West Linton	·44	...	,, .	Glanmire, Lota Lo.	1·07	27
Berk .	Marchmont House	1·57	75	*Kerry* .	Valentia Obsy.	1·17	23
Hadd .	North Berwick Res.	1·35	87	,, .	Gearahameen	·80	...
Midl .	Edinburgh, Roy. Obs.	·46	29	,, .	Killarney Asylum	...	...
Ayr .	Kilmarnock, Agric. C.	·21	7	,, .	Darrynane Abbey	1·59	34
,, .	Girvan, Pinmore	·30	7	*Wat* .	Waterford, Brook Lo...	1·76	54
Renf .	Glasgow, Queen's Pk.	·25	8	*Tip* .	Nenagh, Cas. Lough...	·83	27
,, .	Greenock, Prospect H.	·69	12	,, .	Roscrea, Timoney Park	·73	...
Bute .	Rothesay, Ardencraig.	·28	7	,, .	Cashel, Ballinamona...	·99	31
,, .	Dougarie Lodge	·40	...	*Lim* .	Foynes, Coolnanes	·61	19
Arg .	Ardgour House	·56	...	, .	Castleconnel Rec.	·63	...
,, .	Manse of Glenorchy...	·57	...	*Clare* .	Inagh, Mount Callan...	...	...
,, .	Oban	·48	...	,, .	Broadford, Hurdlest'n.	·96	...
,, .	Poltalloch	·38	9	*Wexf* .	Newtownbarry	...	...
,, .	Inveraray Castle	·60	9	,, .	Gorey, Courtown Ho...	1·17	42
,, .	Islay, Eallabus	·36	9	*Kilk* .	Kilkenny Castle	·63	25
,, .	Mull, Benmore	...	...	*Wic* .	Rathnew, Clonmannon	1·86	...
,, .	Tiree	·46	...	*Carl* .	Hacketstown Rectory..	1·00	33
Kinr .	Loch Leven Sluice	...	...	*Leix* .	Blandsfort House	·95	35
Perth .	Loch Dhu	·70	9	,, .	Mountmellick	·87	...
,, .	Balquhidder, Stronvar	·86	...	*Off'ly* .	Birr Castle	·55	24
,, .	Crieff, Strathearn Hyd.	·81	23	*Dubl* .	Dublin, FitzWm. Sq...	·96	51
,, .	Blair Castle Gardens...	·55	20	,, .	Balbriggan, Ardgillan.	1·12	57
,, .	Dalnaspidal Lodge	...	...	*Me'th* .	Beauparc, St. Cloud...	·94	...
Angus.	Kettins School.	1·63	77	,, .	Kells, Headfort	·64	21
,, .	Dundee, E. Necropolis	1·50	80	*W.M* .	Moate, Coolatore	·57	...
,, .	Pearsie House	2·35	...	,, .	Mullingar, Belvedere..	·57	20
,, .	Montrose, Sunnyside...	1·02	55	*Long* .	Castle Forbes Gdns.	·33	12
Aber .	Braemar, Bank	1·36	48	*Gal* .	Ballynahinch Castle...	·93	18
,, .	Logie Coldstone Sch.	2·05	99	,, .	Galway, Grammar Sch.	·49	...
,, .	Aberdeen, King's Coll.	1·12	55	*Mayo* .	Mallaranny	1·25	...
,, .	Fyvie Castle	2·27	...	,, .	Westport House	·68	17
Moray.	Gordon Castle	·78	41	,, .	Delphi Lodge	·81	...
,, .	Grantown-on-Spey	·77	36	*Sligo* .	Markree Obsy	·72	20
Nairn.	Nairn, Delnies	·61	34	*Cav'n* .	Belturbet, Cloverhill...	·37	14
Inv .	Kingussie, The Birches	·59	...	*Ferm* .	Enniskillen, Portora...	·78	...
,, .	Loch Quoich, Loan	1·65	...	*Arm* .	Armagh Obsy	·86	39
,, .	Glenquoich	·96	9	*Down* .	Fofanny Reservoir	1·43	...
,, .	Inverness, Culduthel R.	·63	...	,, .	Seaforde	·75	25
,, .	Arisaig, Faire-na-Squir	·63	...	,, .	Donaghadee, C. Stn...	·42	18
,, .	Fort William	·65	...	,, .	Banbridge, Milltown...	1·30	...
,, .	Skye, Dunvegan	1·01	...	*Antr* .	Belfast, Cavehill Rd...	·94	...
R & C.	Alness, Ardross Cas ...	1·21	37	,, .	Glenarm Castle	1·36	...
,, .	Ullapool	·87	...	,, .	Ballymena, Harryville	·97	30
,, .	Torridon, Bendamph...	1·14	14	*Lon* .	Londonderry, Creggan	1·15	36
,, .	Achnashellach	1·48	...	*Tyr* .	Donaghmore	1·13	...
,, .	Stornoway	·74	...	,, .	Omagh, Edenfel	·58	19
Suth .	Lairg	1·58	...	*Don* .	Malin Head	1·21	...
,, .	Tongue	1·43	41	,, .	Dunfanaghy	·80	...
,, .	Melvich	2·20	...	,, .	Killybegs, Rockmount.	·87	17

Climatological Table for the British Empire, September, 1929.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1020·1	+ 2·7	85	40	73·0	53·8	63·4	+ 6·3	54·4	89	5·6	0·16	— 1·71	2	6·5	52
Gibraltar	1016·4	— 0·9	86	62	79·8	67·3	73·5	+ 1·0	65·9	85	5·0	1·02	— 0·37	2	..	..
Malta	1016·9	0·0	87	59	78·5	69·5	74·0	— 2·0	68·9	77	4·7	1·55	+ 0·28	6	8·6	70
St. Helena	1015·7	+ 2·2	..	52	..	52·9	..	..	53·4	93	9·8	2·01	— 1·01	19	..	..
Sierra Leone	1013·6	+ 1·4	88	70	83·0	72·3	77·7	— 1·4	74·6	90	6·0	27·23	— 1·25	26	..	..
Lagos, Nigeria	1012·3	— 0·5	88	70	83·9	73·5	78·7	+ 0·3	74·4	83	9·2	3·11	— 2·15	17	..	..
Kaduna, Nigeria	1015·4	+ 2·6	88	..	84·8	..	..	..	70·6	84	..	13·81	+ 2·32	30	..	..
Zomba, Nyasaland	1012·2	— 1·5	88	56	82·6	62·0	72·3	+ 2·8	..	52	1·3	0·00	— 0·34	0	..	..
Salisbury, Rhodesia	1011·8	— 0·4	87	48	81·4	55·1	68·3	+ 1·9	54·6	35	0·9	0·00	— 0·26	0	10·6	88
Cape Town	1019·5	+ 0·4	79	39	65·7	52·4	59·1	+ 1·2	53·7	85	4·6	1·82	— 0·42	10	..	..
Johannesburg	1016·9	— 0·3	78	38	70·6	50·9	60·7	+ 1·3	50·7	63	4·1	3·05	+ 2·09	9	8·1	68
Mauritius	1020·3	+ 0·1	79	57	75·7	63·3	69·5	— 0·6	64·8	66	5·7	1·00	— 0·30	22	8·1	67
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	3·53	+ 2·63	..	..	..
Calcutta, Alipore Obsy.	1006·0	+ 1·5	92	72	89·7	78·4	84·1	+ 1·1	79·4	89	6·5	10·69	+ 0·82	10*	..	..
Bombay	1007·9	— 0·1	95	73	87·1	76·4	81·7	+ 0·9	76·5	86	5·5	5·58	— 5·10	8*	..	..
Madras	1006·3	— 0·2	101	73	92·8	77·7	85·3	+ 0·2	76·0	73	6·2	7·36	+ 2·37	10*	..	..
Colombo, Ceylon	1009·8	— 0·2	87	73	85·8	76·3	81·1	+ 0·2	76·9	76	7·1	10·02	+ 3·80	23	6·8	56
Hongkong	1009·8	+ 1·4	90	75	85·4	77·8	81·6	+ 0·6	76·3	77	6·7	10·79	+ 0·80	16	7·0	58
Sandakan	..	..	91	73	89·2	74·8	82·0	+ 0·3	77·6	82	..	6·53	— 2·86	10	..	..
Sydney, N.S.W.	1019·0	+ 3·0	79	43	65·6	49·6	57·6	— 1·6	52·6	64	4·5	1·56	— 1·33	7	7·6	64
Melbourne	1020·5	+ 4·7	73	35	62·0	44·4	53·2	— 0·9	48·2	69	5·9	1·67	— 0·74	13	5·7	48
Adelaide	1021·7	+ 4·4	78	39	66·8	47·2	57·0	— 0·1	50·1	52	6·2	2·13	+ 0·09	12	7·0	59
Perth, W. Australia	1021·5	+ 3·6	83	43	67·3	48·5	57·9	— 0·4	51·7	61	4·0	2·80	— 0·60	13	8·8	75
Coolgardie	1020·0	+ 2·9	90	36	73·2	45·0	59·1	+ 0·5	49·1	43	2·1	0·00	— 0·61	0	..	..
Brisbane	1019·6	+ 2·3	86	48	74·2	54·4	64·3	— 1·0	57·4	58	4·1	0·48	— 1·57	8	7·5	63
Hobart, Tasmania	1014·7	+ 4·0	65	34	58·0	43·2	50·6	— 0·2	44·6	63	6·9	1·64	— 0·49	19	5·6	47
Wellington, N.Z.	1014·9	+ 0·3	61	34	54·5	42·3	48·4	— 3·2	46·0	72	6·0	3·29	— 0·68	13	6·8	58
Suva, Fiji	1014·0	— 0·3	86	60	78·7	68·0	73·3	— 1·2	69·2	76	6·3	6·31	— 0·67	16	5·4	45
Apia, Samoa	1011·5	— 0·6	88	69	83·9	73·2	78·5	+ 0·3	75·1	73	4·1	2·29	— 2·83	12	7·4	62
Kingston, Jamaica	1011·8	— 0·4	89	68	87·1	72·7	79·9	— 1·6	72·3	89	6·4	2·42	— 1·61	9	6·3	51
Grenada, W.I.	1009·1	— 2·6	89	71	86·7	73·4	80·1	— 0·1	74·9	79	6·8	14·10	+ 5·84	18	..	..
Toronto	1018·5	+ 0·7	94	37	71·0	53·4	62·2	+ 3·0	54·0	77	4·4	0·78	— 2·40	6	6·2	50
Winnipeg	1016·0	+ 1·2	99	27	62·1	42·2	52·1	— 1·3	42·9	90	6·4	2·39	+ 0·11	5	5·2	41
St. John, N.B.	1019·7	+ 2·2	74	37	64·8	49·7	57·3	+ 1·4	53·5	81	5·6	4·35	+ 0·61	14	5·4	43
Victoria, B.C.	1016·8	+ 0·3	82	45	69·2	51·0	60·1	+ 4·5	53·8	69	2·6	0·10	— 1·91	3	8·2	65

CORRIGENDA.—The **Observations for Lagos, Nigeria,** for June and July 1929 *should read:—*

June ..	1012·9	0·0	85	70	83·6	73·2	78·4	—0·9	74·7	88	9·1	24·79	+6·14	22	..	..
July ..	1013·0	—0·8	83	70	81·1	73·9	77·5	—0·5	74·6	88	9·3	19·93	+9·25	21	..	..

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

M.O. 326.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 65
April 1930
No. 771

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:
ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH;
YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 15, DONEGALL
SQUARE WEST, BELFAST; or through any Bookseller.

Experiments with Wet Bulb Thermometers.

In the *Meteorological Magazine* for December, 1928, p. 253, some account was given of experiments with wet bulb thermometers at Kew Observatory. Further experiments were made during the spring and summer of 1929. The principal results of these experiments are:—

(1) In the Stevenson screen wet-bulb thermometers give consistent readings when the water is either—

(*a*) Distilled water sucked up from a bottle at a lower level.
(*b*) Distilled water supplied from a reservoir at such a height that the water drips slowly.
(*c*) Tap water* supplied in this way.

(2) If tap water is sucked up from a bottle at a lower level than the wet bulb then the readings are at first consistent with those obtained with the arrangements mentioned in the preceding paragraph. After about four days the wet bulb supplied with tap water becomes less efficient and the readings of this thermometer are higher than those of the other thermometers; the excess is likely to be 0·5°C. at the end of a week and may be as great as 3°C. at the end of three weeks of hot weather.

(3) Vapour pressures determined for the free air outside a Stevenson screen by the Assmann psychrometer and for the inside of the screen by the ordinary dry and wet bulb generally agree within 0·5 mb. (the readings being reduced in each case

---

*Actually boiled tap water was used in this series of experiments.

(88984) P.S. 14/89 1,050 4/30 M. & S. *Gp.303*

by the appropriate formulæ and the wet bulb in the screen having an adequate water supply). The formula regarded as appropriate for the reduction of the observations in the Stevenson screen is that adopted by the Meteorological Office $e'-e=\frac{4}{5}(t-t'.)$ This is almost identical with Regnault's light wind formula.

The conclusions stated in paragraphs (1) and (3) are satisfactory. As long as there is an adequate supply of pure water to the wet bulb thermometer in the Stevenson screen readings will be obtained for which the accepted psychrometric formula is the right one. Moreover, it is not necessary to use distilled water or rain water, boiled tap water will serve provided that the supply is so generous that the water continually drips.

On the other hand the conclusion stated in paragraph (2) indicates the great importance of avoiding the concentration of salts on the muslin of the wet bulb. Probably there are a good many meteorological stations where the rain water is not clean enough to use in the bottle supplying the wet bulb and where tap water is used as a substitute. The investigation shows that it is a very bad substitute, but that the ill effects are obviated by allowing the water to drip continually from the wet bulb.

In the *Observer's Handbook* it is stated that hard water should not be used for a wet bulb as lime is deposited from the hard water on the bulb. The case is really stronger than this, since softened water, which contains sodium salts in place of the calcium salts of hard water, would also be unsuitable for wet bulbs. When evaporation takes place from a solution of salts in water, it is pure water that is carried away as vapour, the salts are left behind. As evaporation proceeds the solution becomes richer and evaporation is thereby retarded. So the wet bulb thermometer with a rich solution of salt on the muslin gives readings which are too high. With the water supply so liberal that drips fall from the wet bulb, the enrichment of the solution by evaporation is not appreciable and normal readings are obtained.

At Kew Observatory the water supply to the thermometers in the north wall screen has always been of this liberal character. The water used is boiled tap water. Boiling, as is well known, removes the "temporary hardness" due to carbonate of lime. but the "permanent hardness" due to sulphate of lime as well as other salts remain in the water. Nevertheless, there is no indication that in this instance the salts retard evaporation Whether the system was adopted deliberately is not on record. Most likely the reservoir was placed high so that the flow of water should suffice to keep the whole of the wet bulb moist in dry weather. That the water actually drips from the bottom of the bulb is a happy accident.

The moral is, however, that any observer who finds it inconvenient to use distilled water should arrange for a continuous drip from his wet bulb.

Bottles designed to give a supply of water at a constant level can be obtained from the Meteorological Office. The only drawback is the heavy risk of breakage by frost. This risk may be obviated by passing a rubber tube through the neck of the bottle, the tube being filled with air. This arrangement looks rather clumsy, however, and I hope that some alternative will be invented.

I should like to learn whether the dripping wet bulb has been tried at any meteorological stations near the coast. It has been demonstrated frequently that the deposit of salt from spray makes subsequent wet-bulb readings useless. The evil might be reduced considerably if the thermometers had a liberal supply of distilled water.

F. J. W. WHIPPLE.

Observations of Temperature close to the ground on clear calm nights

By E. V. NEWNHAM, B.Sc.

It is well known that on clear and not very windy nights the reading of a properly exposed grass minimum thermometer is generally several degrees below that of the thermometers in the ordinary Stevenson screen. It is natural to suppose that the grass minimum is cooled by radiation below the temperature of the surrounding air, for it readily becomes dewed or covered with hoar frost, and in the latter case the instrument is often heavily coated with ice by sunrise. If it were not for this fact one might suppose that the thermometer indicates the temperature of a shallow layer of air that becomes greatly cooled by contact with the chilled grass. If such a layer were formed, it would tend on account of its density to become impervious to the action of turbulence, and therefore could go on becoming colder without dilution with relatively warm air from above. L. G. H. Dines* has made some comparisons between the readings of a grass minimum thermometer set an inch above short grass and those of an aspiration psychrometer set with its air intake at the same height. The psychrometer readings were found to be higher; the mean difference was as much as 3°F. on a number of occasions when the average reading of the grass minimum was 17°F. Objection might, however, be taken to this method of measuring the air temperature, on the ground that most of the air entering the psychrometer may have come from a higher level.

It seemed possible that by using mercury thermometers with

---

*See *Meteorological Magazine*. 59, 1924 p. 12.

very small bulbs an approximation to the lapse-rate of temperature in the first few inches above a grass lawn on clear still nights might be obtained, perhaps even an approximation to actual air temperatures. Accordingly, numerous sets of observations were made during the very cold nights of February and early March, 1929, with six mercury thermometers having cylindrical bulbs of from 2½ to 4 mm. diameter. They were mounted horizontally at right angles to a slender wooden rod drilled to receive them, and a fine metal point at the end of the rod allowed of its erection on a lawn, which was covered with good turf one inch thick. In the table some typical readings, corrected for index error, are given. It should be noted that heights are measured from the ground underlying the grass; the reading $T_{1''}$ is for about the level most appropriate for a grass minimum thermometer, if the purpose of that instrument is to indicate the region of lowest temperature—*i.e.*, for the level of the tips of the grass blades. $T_{1''}$ was always observed to be a degree or two higher than the temperature indicated at the same instant by two standard grass minimum thermometers set at the same height a few feet away; the latter soon became dewed, whereas the small thermometers very rarely were, and it can be assumed that the latter gave readings more nearly corresponding with true air temperature. The readings were made lying flat on the ground, from behind a small wooden screen, to shield the thermometers from any radiation from the observer's body, but this was eventually found to be unnecessary.

It is only to a very limited extent that the figures in the table speak for themselves; to try to understand the physical processes at work it is necessary to take note of things that could not be measured with any apparatus available. An important point is that these rather sensitive thermometers were generally observed to give incessant variations, often rising or falling a degree in a minute or less, except when the bulb was set below the top of the grass. The calmest possible nights were chosen; usually the drift of cigarette smoke along the grass was of the order of ½ m.p.h. or less, but on rare occasions when a slight air movement could momentarily be felt, all thermometers above the grass would at once rise a degree or two, soon recovering their lower readings again afterwards, and it seemed likely that even the smaller and nearly incessant variations were caused by a turbulence of the air that one would not have expected under such conditions. This turbulence was evident on comparing the rapid dispersion of a small puff of smoke on the grass with the very leisurely dispersion of a similar puff in a closed room with no fire. The manner in which the smoke puff was dispersed was not such as might have been expected merely from the instability of the warm cloud in its cold surroundings. It is difficult to give a correct impression of the process in words.

When the obvious disturbance caused by expelling the smoke cloud had died down and the latter lay nearly motionless or drifted very slowly over the grass, an irregular turbulent movement could be seen that did not appear to be dying down and which so scattered the smoke that the puff could not be followed for more than about 5 or 10 seconds. Such free interchange of air over the first few inches of height appears incompatible with the idea of a strong stratification of the air in question into layers of different temperature, such as the readings appear to indicate, and it was therefore concluded that the thermometers, in spite of their general freedom from dew, were not indicating even approximately the true mean air temperature at the same level. It was observed that on those occasions when perceptible light airs were noticeable at times along the grass, $T_{\frac{1}{2}}$ was only slightly affected, if at all, and on a few nights when there was a sustained air drift, $T_{\frac{1}{2}''}$ was the lowest reading, e.g., on March 9th with a drift of nearly 2 m.p.h. $T_{\frac{1}{2}''}$ was from 3° to 4° below $T_{1''}$. The observations of Aitken* and Franklin‡ show, however, that at a lower depth in the grass much higher readings are to be expected. The figures for the surface earth temperature (the thermometer bulb just covered by the earth underlying the grass) for February 14th-15th given in the table, may be noted in this connexion. Returning to the question as to how nearly the thermometers indicated air temperature, one of them was used as a sling thermometer, and was whirled in a horizontal plane, but risk of breakage made it impracticable to do this in the most interesting region just above the grass tips. On February 14th at 11—11.30 p.m., in an estimated wind of 1 m.p.h. $T_{5''}$ by sling thermometers was 1° higher than $T_{5''}$ on the stand, and in a lighter wind (about ½ m.p.h.) there was a difference of 1·1° for $T_{10''}$. Even in a comparatively strong wind reaching 6 or 7 m.p.h at times (on March 1st, 11.15—11.30 p.m.) $T_{5''}$ by sling was 0·5° to 0·6° higher than $T_{5''}$ on the stand. It was found that encasing the thermometer bulbs with polished German silver shields, leaving an air space between the shield and the bulb, seemed to have no effect on their readings, and a difference of 1·1° was noted on March 9th, 1929, in a 2 m.p.h. wind, between whirled and stationary shielded thermometers at 5¼ inches. This result is in accordance with Aitken's observations† that most common substances including polished metals and blackened metal appear to radiate equally well at temperatures such as those that we are dealing with.

General Conclusions.

If the interpretation of the behaviour of smoke over the grass

---

* "On dew", *Collected Papers*, pp. 139 and 142.

‡ "The cooling of the soil at night", *Proc. Royal Soc. Edinburgh* XXXIX, p. 120.

† "On dew", *Collected Papers*, pp. 160-5,

TABLE I—READINGS OF SMALL MERCURY THERMOMETERS ON CLEAR NIGHTS.

The suffixes 1″, 3″, etc., refer to height above solid ground; subtract one inch to get height above tips of grass blades.

	TIME G.M.T.	$T_{1''}$	$T_{3''}$	$T_{5''}$	$T_{7''}$	$T_{9''}$	T_{1} ″
Feb. 3rd, 1929. Very dry air. Wind at chimney level about 5 m.p.h. from between E. and N. Perceptible air movement along ground from N.	h. m.						
	19 00	26·2	28·2	28·6	28.7	28·7	28·8
	22 00	25·2	28·4	28·3	28.4	28·5	28·4
	22 10	25·2	28·0	28·4	28.7	28·7	28·7
	22 25	24·1	27·5	27·8	28.3	28·8	28·8
Feb. 8th, 1929. Not quite so dry. Light easterly airs at chimney level, increasing. Perceptible movement along ground as often from S. as from N. All thermometers dewing very slightly.	23 47	26·3	28·1	28·2	28·7		28·8
	23 52	26·7	28·2	28·5	28·7		29·1
	24 13	26·0	27·5	28·2	28·6		29·0
	24 30	26·6	28·1	28·5	..		28·8
	24 37	27·6	29·6	30·3	30·9		31·3
	24 42	27·2	30·7	30·7	30·9		31·2
	24 44	28·7	30·3	30·7	30·9		31·3

	TIME G.M.T.	$T_{\frac{1}{2}''}$	$T_{1\frac{1}{2}''}$	$T_{3''}$	$T_{5''}$	$T_{10''}$	T_{earth}
	h. m.						
Feb. 13th-14th, 1929. Wind at chimney level NNE. increasing gradually to about 10 m.p.h. Perceptible movement along the ground mainly from E. shows how increase of wind may cause lowest reading to be below tips of grass blades.	22 14	12·4	12·8	13·5	13·8	13·9	
	22 17	12·4	12·8	13·4	13·7	13·8	
	22 20	12·7	13·3	14·2	14·3	14·4	
	22 45	13·1	8·8	12·9	13·3	13·4	
	22 48	12·4	8·8	12·4	12·9	13·3	
	3 59	14·1	15·3	15·6	15·8	16·2	
	4 1	14·1	14·8	15·2	15·6	15·7	
	4 2	14·1	14·7	15·1	15·3	15·4	
	4 4	14·0	14·8	15·2	15·5	15·7	
	4 5	14·1	15·2	15·4	15·7	15·8	
Feb. 14th, 1929. Wind at chimney level W.-NW. 3-4 m.p.h. Tendency for drift from S. and SE. along the ground.	22 54	12·0	12·7	13·2	13·8	14·3	(20·4)
	22 56	12·1	12·7	13·7	14·2	14·4	
	22 59	12·0	12·2	13·2	13·7	14·2	
	23 1	12·1	12·8	13·5	14·3	15·0	(20·3)
	23 28	10·9	11·2	11·8	11·9	12·2	
	23 30	11·2	10·8	11·8	12·2	12·3	(20·2)

given above is correct, considerable turbulence appears to be usual close to the ground in a suburban garden even under a clear night sky in quiet weather when conditions would appear to be most favourable for a high degree of stratification. When, however, it is considered that at such times every solid object is tending to cool several degrees below the temperature of the surrounding air, this is perhaps not surprising, for every such object must be a continual source of descending air currents.

It would be interesting to have more accurate information as to what happens not only in suburban surroundings but in open country. If sensitive electrical resistance thermometers could be employed the true air temperature might be measured, and the fine wire of such thermometers would presumably not introduce any appreciable disturbance of natural conditions. The designing of apparatus sensitive enough for measuring small scale turbulence might, however, prove difficult.

The rough experiments described in this note seem to suggest that the definite instruction, in the official handbooks that appeared before the modern "Observers' Handbook," to set a grass minimum thermometer so as just to touch the tips of the grass blades, might be re-introduced with advantage as a step towards getting comparable observations from different stations, and an even greater degree of comparability would result from the employment of a "radiation box" as advocated by Aitken.† It might of course be argued that the object of grass minimum readings is to get information as to what degree of cold plants are subjected to, and not measures of terrestrial radiation, but very little vegetation is so situated as to experience such a degree of cold as the upper part of thick turf, and it is a matter of common observation that plants readily injured by frost normally survive a night with a sharp "ground frost," as indicated by the "grass minimum," so long as the temperature in the screen does not fall below 32°F. For these reasons it might be better to make the measurement one of terrestrial radiation. In any case the use of the term "ground frost" in connexion with grass minima is unfortunate, for the influence of the ground appears to be all in the direction of preventing frost owing to its being a moderately good conductor of heat and, on clear nights, having normally a temperature much above that of the overlying air.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday evening, March 19th, at 49, Cromwell Road, Mr. R. G. K. Lempfert, C.B.E., M.A., F.Inst.P., President, in the Chair. As is customary in March, the meeting took the form of a lecture (The Symons Memorial Lecture), which was delivered on this occasion by Dr. Herbert Lapworth, M.Inst.C.E., his subject being

---

† "On dew," *Collected Papers*, pp. 158-9.

Meteorology and Water Supply.

The lecturer dealt mainly with the story of the rain between its precipitation as rainfall on the surface of the ground and its later appearance in the form of streams, springs and underground water, that is to say, a brief outline of the sciences of hydrology and hydrogeology as bearing upon the preliminary investigation of the water-engineer.

It was pointed out that precision in water-supply problems can only be obtained by the collection of data in these two sciences and in rainfall statistics. The lecturer stated that water-engineers started from the basis of rainfall, the laws of flucuation of which were regarded by the water-engineer as more precise than the laws of hydrology and hydrogeology. Nevertheless the preliminary investigations of water supply were based upon nineteenth century rainfall observations, whereas there was good evidence that in the previous century there had been longer and worse droughts than any which had occurred during the period covered by the observations. If such conditions recurred probably no waterworks in Britain could adequately meet them. After discussing the driest years, on which basis waterworks were designed, the lecturer dealt with floods and stream flow in general, reviewing the relation between rainfall and run-off and the losses due to evaporation and other causes in streams and underground water. The movement of underground water, the formation of springs and the fluctuation of water-level were then described, including references to bournes and disappearing streams and rivers. The question of wells and the effects of pumping were then treated, and the artesian basins of the world were briefly noted, illustrating the immense distances travelled by underground water. Finally, the lecturer paid tribute to Drs. Symons, Mill, Salter and others for their investigations on British rainfall, an arduous task carried out under great difficulty, but of immense value to the profession of the water-engineer.

Correspondence

To the Editor, *The Meteorological Magazine.*

Low March Temperatures

The following may be of interest to you. On the morning of March 20th my grass minimum thermometer showed 30° of frost and that in the screen 19° of frost. This is the lowest reading I can remember here in March. We had also 4 inches of snow. Both thermometers are by Negretti & Zambra.

R. G. C. Sandiman.

Dany Parc, Crickhowell, South Wales. March 21st. 1930.

Abnormal Vertical Air Currents

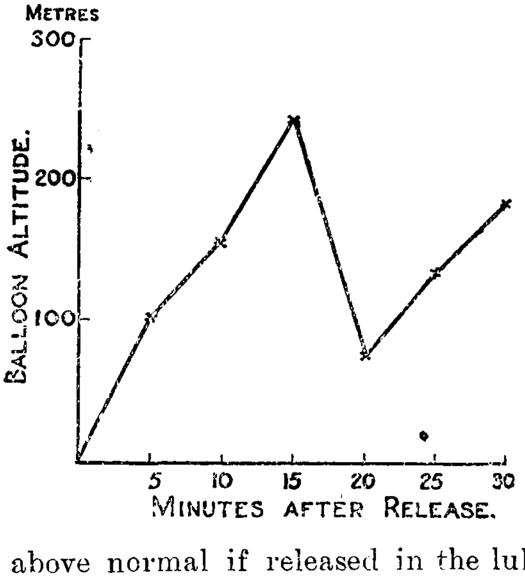
An example of a strong descending air current was observed during a pilot balloon ascent on December 18th, 1929. A moderate breeze was blowing with the sky 0·6 overcast.

The balloon, weighing 20 gm., was inflated according to the Dines formula to ascend at 150 m./min. The height of the balloon was determined by both the range-finder and the tail method. The results of the flight are given in Table I :—

TABLE I.—PILOT BALLOON OBSERVATION SHOWING ABNORMAL DESCENT.

Time	Altitude			Wind	
	Tail Method	Range Finder	Mean	Velocity	Direction
min.	m.	m.	m.	m./sec.	°
0·0	—	—	—	13·4	315
0·5	102	122	112	8·8	317
1·0	166	143	154	14·1	336
1·5	252	232	242	12·6	337
2·0	78	69	74	15·6	336
2·5	137	130	134	13·7	336
3·0	185	179	182	9·6	338

From Fig. 1 showing the altitude of the balloon at half-minute intervals it is seen that the balloon should have reached an altitude of 300 m. at the end of the second minute. The observed height was only 74 m. In half a minute the balloon actually fell a distance of 168 metres. This indicates a downward air current with a velocity of 486 m./min., or 8·1 m./sec. After this gust the balloon rose at approximately the normal rate of ascent until lost in scud in the following minute. In general, rates of ascent below normal are observed when balloons are released during a gust, but above normal if released in the lull following the gust.



The altitudes given in Table I show the nature of agreement obtained under adverse observing conditions with tail and range-finder methods of determining the height of pilot balloons.

ANDREW THOMSON.

Meteorological Office, Wellington, New Zealand.

The Atmosphere as a Colloid

In the September issue of the *Meteorological Magazine* Dr. F. J. W. Whipple, reviewing " Die Atmosphäre als Kolloid " of Schmauss and Wigand, refers on page 194 to the experience of Major Holtzey of Lindau, looking down on a sea of mist over the Rhine Valley. This was so shallow that church towers stood out above it. It was cloudless overhead. " On the return journey the party walked into the mist and after ten minutes they were soaked through with rain." Dr. Whipple asks, " Can a parallel be found for this experience? It is surely inconsistent with all current ideas as to rain formation to assume that the rain-drops developed in the low-lying mist."

The following example shows a rather unusual condition of liquid drops in a fog at Blue Hill Observatory. The preceding 24 hours were warm with much haze, and a typical Indian Summer day. Surface temperature in afternoon 19°C., relative humidity 60 per cent., absolute humidity 10 grams per cubic meter of space, temperature of condensation 11°C, height of base of small cumulus clouds 1,200 meters, surface wind, SW, velocity 10 meters per second, velocity of cloud 16 m/s moving from W.

This condition was followed by a veering of the wind to NE by N velocity 4 m/s, temperature 10°C., vapour pressure 12·3 kilodynes per square centimeter (or millibars), saturation weight 9·4 grams per cubic meter, resulting in fog containing a large number of liquid particles. A screen of fine mesh, at right angles to the flow of the fog caught in a short time, a large number of drops, average surface area of drops, 12 square millimeters. The droplets were carried along horizontally. A screen in fog but sheltered from the flow did not show any drops. It seems like a clear case of condensation and further deposition on the haze particles.

Fogs of this type in this vicinity, under anticyclonic regimen, are, as a rule, shallow, often only 200 meters in depth. On December 14th, 1929, 11 a.m., fog covered New York City, but being only 100 meters in thickness it was pierced by the tops of the tall buildings.

ALEXANDER MCADIE.

Harvard University, Blue Hill Observatory, Readville, Mass. February 20th, 1930.

Minimum Temperatures on "Radiation Nights"

In the *Meteorological Magazine* for December, 1927 (p. 260), one of us, in conjunction with Mr. J. Paton, gave approximate equations connecting the screen and grass minimum temperatures recorded in " winter " (October to March, inclusive) at Cranwell, Lincolnshire, on " radiation nights." It has since been thought that a similar piece of work for a sea-coast station was called for, for the purposes of comparison. Calshot was the station chosen. The period examined stretched from October 1st, 1923, to March 31st, 1928, a "radiation night" was defined as in the previous note as one in which the mean cloud amount at 18h., 1h., and 7h. G.M.T. was four-tenths or less, and the screen and grass minimum temperatures were those measured at the last mentioned 7h.

In determining the equations representing the relationship a two-fold differentiation was made with regard to wind speed during the night, as measured by a Dines anemometer whose head is 43 feet above ground level, taking the average of the readings at 18h., 1h., and 7h., as criteria, and then each such wind group was further sub-divided according as to whether the relative humidity at the preceding 15h. G.M.T. was less than 85 per cent or no.

Using T as the screen minimum temperature and G as the grass minimum temperature, the four equations found were as follows :—

Mean Wind Speed	Relative Humidity at 15h.	Equation	No. of cases
8 miles per hour or less	> 85 $=$ or < 85	$T = 1.5G - 10.0$ $T = 1.1G + 5.6$	8 51
Greater than 8 miles per hour	> 85 $=$ or < 85	$T = G + 3.8$ $T = G + 6.7$	35 146

Comparing the results for Cranwell, the inland station and Calshot, the sea-coast station, the main result appears to be that for low wind speeds (8 m.p.h. or less) the difference between the two minima is greater at Calshot than it is at Cranwell. For the higher wind speeds no such general result can be stated.

W. H. Pick.
D. F. Bowering.

Halo and Parhelia

This afternoon the halo of 22° and its parhelia were observed at 15h. The halo itself was very faint but it was quite possible to see the gap separating it from the two parhelia. These latter showed prismatic colours and at first were quite faint, but about 15h. 3m. became much brighter. Before observations ceased about 15h. 15m. the halo had faded, leaving the parhelia. The parhelia had no "tails."

Halo phenomena seem to have been frequent this month, solar halos being noted on the 6th, 17th, 18th and 20th, and lunar halos on the 10th and 11th.

Cicely M. Botley.

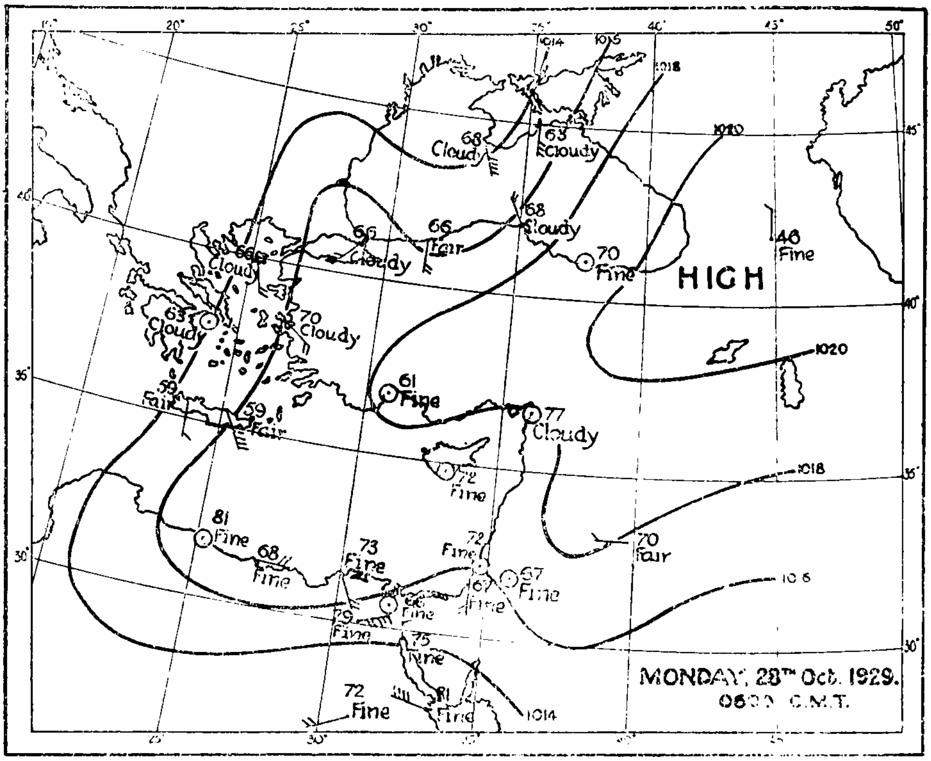
Guildables, 17, *Holmesdale Gardens*, *Hastings*. *March* 20*th*, 1930.

NOTES AND QUERIES

Formation of Fog in Lower Egypt on October 29th and 30th, 1929.

A very good illustration of the principles underlying fog formation occurred in Egypt on October 28th, 1929, prior to the formation of dense fog over the Cairo, Helwan, Abu-Sueir, Ismailia district on October 29th and 30th, 1929.

An intense anticyclone (1,038 mb.) was centred over eastern Russia and extended its influence southwards over the eastern Mediterranean, Egypt, Palestine and Transjordan. In Palestine and Transjordan winds were SE'ly 15-25m.p.h. and in Egypt NE.-ENE. 30-35m.p.h., decreasing with height. The synoptic chart for 6h. G.M.T. on October 28th is reproduced. At this hour the wind at Ismailia was calm, temperature 66°F. and humidity 82 per cent., while at Heliopolis the wind was ENE. force 5, temperature 79°F. and humidity 31 per cent. Such striking differences in wind, temperature and humidity at two places situated apparently in the same air stream can be explained as follows:—


MONDAY, 28TH Oct. 1929.
0600 G.M.T.
20°
25°
30°
35°
40°
45°
50°
45°
40°
35°
30°
1014
1015
1018
1010
1020
1018
1016
1014
HIGH
68
Cloudy
63
Cloudy
66
Cloudy
66
Fair
68
Cloudy
70
Fine
46
Fine
66
Cloudy
63
Cloudy
70
Cloudy
61
Fine
59
Fair
59
Fair
77
Cloudy
72
Fine
81
Fine
68
Fine
73
Fine
72
Fine
67
Fine
67
Fine
66
Fine
79
Fine
75
Fine
70
Fair
72
Fine
81
Fine

Air descending in the old established anticyclone to the east flows off on a gliding surface which slopes downwards towards south and southwest.* This gliding surface cuts the ground between Ismailia and Heliopolis, probably very near the latter place. The high temperature and low humidity at Heliopolis result from the heating of the air as it descends this gliding surface. The essential condition for fog formation, viz., the temperature inversion, is therefore present in a very striking fashion. Fog will form in the cool air beneath the gliding surface whenever the NE'ly wind becomes sufficiently damp and sufficiently cooled by nocturnal radiation. This did not happen on the 28th at Ismailia, although the humidity at 3h. G.M.T. was 94 per cent. (compared with 44 per cent. at Heliopolis). On the 29th Heliopolis was no longer in the warm upper zone (the surface having moved further south) and thick fog resulted over a considerable area.

---

* For a discussion on these gliding surfaces and their relation to fog formation *see* W. Georgii. Ann. Hydrogr., Berlin, XXXXVIII, 1920, p. 207.

Very similar conditions were recorded at 6h. G.M.T. on November 18th, 1929.

	Heliopolis.	*Ismailia.*
Wind	Force 4	Calm
Temperature	66°F.	57°F.
Humidity	73 per cent.	100 per cent.

In this case fog had actually developed at Ismailia on the 18th, but it occurred extensively from November 19th-21st after the gliding surface had moved further south and west.

J. DURWARD.

Hurricanes in the Fiji Islands

The "hurricane season" of the Fiji Islands occurs in the summer months of the southern hemisphere. In each season, on the average about one hurricane is experienced; occasionally the track traverses the group of islands, but usually it recurves round the western point of the group.*

Observations relating to two recent hurricanes have been passed to the Meteorological Office by Captain E. W. G. Twentyman, M.B.E., who is in charge of the meteorological work at Suva, Fiji. The first occurred on December 10th-13th, 1929. Frequent extra observations besides the usual daily pair of climatological observations were made at Suva, and from these it appears that the hurricane centre passed through the Fiji group. On December 10th, strong winds from ESE. were experienced, with heavy rain. On the 11th a gale blew from south-east during most of the day, in the early morning of the 12th a veer to south occurred and the wind increased to force 11 on the Beaufort Scale, a velocity of 74 m.p.h. being recorded by the pressure tube anemometer at 3h. 5m. (zone time). Later the wind veered to SW. and decreased somewhat, but blew with gale force during most of the day. In the 24 hours ending at

---

*Compare the description of a hurricane at Suva in the *Meteorological Magazine*, 64, 1929, p. 168.

8h. 30m. on the 11th slightly over 11 inches of rain fell. Captain Twentyman hopes to prepare a detailed report on the storm when observations from other islands are collected.

The second hurricane occurred on January 11th-12th, 1930. Observations have been collected from a few outlying stations which enable the approximate track to be deduced as passing over the islands of Mokongai, Wakaya and Ngau, during the night of the 11th and early morning of the 12th. The hurricane, while causing winds to reach force 11-12 at places over which the centre appears to have passed, lasted only about three hours; and the rate of travel appears to have been a little under 10 m.p.h. The centre probably passed within about 50 miles of Suva, where the storm was not felt. It is interesting to note that a prolongation of the track of this storm passes near the island of Totoya, where a hurricane was experienced on December 11th-12th, 1879.

S. T. A. MIRRLEES.

Old Weather Diaries, Goodwood House, 1798—1806

His Grace the Duke of Richmond and Gordon, M.V.O., has been good enough to present to the Meteorological Office an interesting and valuable weather record maintained at Goodwood House, Sussex, from 1798 to 1806. The volume for 1801 is unfortunately missing, but the record is otherwise practically complete from January 1st, 1798, to December 29th, 1806.

Observations of pressure, temperature and wind are given three times daily, at 8 a.m., 2 p.m., and 8 p.m. Rainfall was measured daily at 8 a.m. from February 14th, 1798, onwards, and daily notes on the weather are also given. For the greater part of the period readings from two different barometers and three thermometers are entered. For " Barometer No. 1," made by Ramsden, readings of the attached thermometer are also given. All the observations are entered in a beautifully clear " copper-plate " hand, and the whole record is in an excellent state of preservation.

The volume for 1798 opens with a detailed description of each instrument with full particulars of its exposure. The two barometers and three thermometers were carefully inter-compared and the results are tabulated. Unfortunately no details of the raingauge and its exposure are given.

Thanks are due to Mr. S. Capon, Goodwood Gardens, for bringing this record to the notice of the Office.

A Simple Equation for Heavy Rainfalls in Short Periods

In *British Rainfall* special mention is made of all falls of rain of 2 hours or less reaching an intensity referred to as "noteworthy." This classification is effected by reference to a diagram which indicates by a continuous curved line the lower limits of rainfall which must fall in stated periods so as to be classified as " noteworthy," for example, a fall of 1·23 inch or more in 2 hours, 1·00 inch or more in 1 hour, 0·70 inch or more in 30 minutes, 0·43 inch or more in 15 minutes and 0·20 inch or more in 6 minutes. I have noted recently that the simple equation $i = \frac{100}{t + 40}$ (where i is the intensity in inches per hour and t is the time in minutes) represents closely this limiting intensity.

Heavy falls in short periods are of particular importance to those who deal with the disposal of flood water, and in the numerous papers on the subject, it is usual to connect the intensity of the rain and the duration of the storm by equations either of the form $i = \frac{k_1}{t + k_2}$ or $i = k_1 t^{k_2}$ where k_1 and k_2 are constants. My own experience is that the former type of equation is a closer approximation to the observations for the British Isles. The equation $i = \frac{100}{t + 40}$ gives values for the rainfall for all values of t up to 120 minutes, within 0·03 inch of the curve of limiting values of " noteworthy " falls given in *British Rainfall.*

During the last 60 years the mean number of " noteworthy " falls reported from all the observing stations over the British Isles has been only about 34 a year. Thus, such falls at any particular station are rare. It is only at stations where recording rain-gauges are in operation that all such falls can be detected, special readings before and after the storm having to be made at stations with ordinary gauges. Most stations in England and Wales with recording gauges have experienced three such falls in seven years (for $t = 10$, 20, 30 and 60) of an intensity at least equal to that given by the equation $i = \frac{40}{t + 15}$. In this equation the values for i are naturally much smaller for similar values of t than in the previous equation.

The enunciation of a simple equation defining " noteworthy " falls may be especially helpful to observers who have the opportunity of adding to our records on this subject but to whom the diagram is not readily available.

J. GLASSPOOLE.

A Suggested Annual Recurrence of Short Periodicities

In the introduction to the *Report and Results of Observations of the Fernley Observatory, Southport,* for the year 1928, Mr. J. Baxendell gives an account of the further progress of his research into periodicities. The interesting experiment was tried of examining the frequency of cold winds (N., NE. and E.) at Marchside separately for each of 30 years. The results for the individual years differ greatly, but the final curve, for the thirty combined, shows maxima near 24, 33 and 38 days. The 33 day periodicity had previously been found in Greenwich temperatures for 1841-50. " It seems difficult to believe that this term can be exactly one-eleventh of a year in length, and so, possibly, it does commence afresh in most years . . . in that case, its operation might go far to account for the remarkable fact that, on the average of very many years, the earlier halves of June, July, August and September are decidedly drier and finer than the later halves."

Climatic Atlas of Japan

The Central Meteorological Observatory, Tokyo, has issued a very fine series of charts and tables under the title *Climatic Atlas of Japan and her Neighbouring Countries.* In the preface it is pointed out that thirty years have passed since the previous publication of climatic charts from Japan and during that period a very rich supply of material has become available, including hourly or four-hourly data for about one hundred stations. The new charts are based on observations for the thirty year period 1897 to 1926, except the rainfall charts, which refer to the interval 1901 to 1925.

The charts cover the Japanese Islands, southern Saghalien, Korea and Formosa, and the neighbouring parts of Manchuria and China. They are 95 in number, artistically printed in several colours, and the registration is remarkably accurate. All elements are represented, including temperature, pressure and winds, humidity, cloudiness and sunshine, number of clear and cloudy days, dates of first and last frosts and falls of snow, and evaporation. The charts are followed by 27 pages of tables giving normal values.

Reviews

The Growth of the World and of its Inhabitants. By Professor H. H. Swinnerton, D.Sc. 7½ x 5 in. pp. 208, *Illus.* London: Constable & Co., Ltd., 1929. 5s. net.

The main interests of the author of this little book lie in rocks and fossils, and with those aspects of science he deals in a very competent and readable manner. Apart from a chapter on " Water and Air," meteorology enters little into the story, but now and again the part played by climatic vicissitudes is brought before the reader, especially towards the close in the sections dealing with the origin of man. The question of continental drift is discussed without bias, and forms the subject of a useful chapter. Another deals with the " Calendar of the Ages," and it is remarkable that here the author does not once mention the method of age determination by measuring the products of radio-activity. He gives as a " sober estimate " of the duration of geological time since the beginning of the Palæozoic a total of 96 million years, in contrast with the figures of the order of 450 to 500 million years now current.

Der Europäische Monsun. Eine synoptische Darstellung seiner Erscheinungsformen, seines Verlaufs und seiner Ursachen. By Geert Roediger. Leipzig, Veröff Geoph. Inst. Univ. 2nd Series, Vol. IV, Part 3, pp. 119-177, 1929.

With the approach of summer temperature does not rise steadily over Europe, but passes through a series of waves, each crest and trough being generally higher than the preceding ones. These fluctuations are for the most part obviously caused by the passage of an irregular succession of barometric depressions and anticyclones, causing alternating northerly and southerly winds, but a tendency has often been remarked for some of the major fluctuations to occur at about the same time in most if not all years. These quasi-regular ups and downs of temperature have attained some celebrity in this country as the " Buchan periods." This paper by G. Roediger analyses the phenomena associated with two " cold spells " in Europe, the average dates being May 16th to 20th and June 5th to 15th. The phenomena are attributed to monsoon-like currents of cold polar air which cross Europe at about the dates mentioned, as a result of the summer lowering of pressure in the interior of the continent. The course of events is briefly summarised by the author as follows :—

" 1. From the end of April to the end of May, precursor of the monsoon. As high pressure still prevails in Asia, the north-west winds penetrate only to central Europe. The cold periods in May accompany such monsoon precursors. From 1890 to 1909 the average time for these advances is the pentad May 16 to 20."

" 2. From 5 to 15 June monsoon inbreak. Asia now has low pressure, while over the North Atlantic Ocean a ridge of high pressure is developed from the Azores to Greenland. Vigorous north-west winds blow across Europe into Asia and cause a marked fall of temperature, accompanied by thunder. The air transport is for the most part from polar regions."

After June 15th the winds blow from WNW. and consist principally of equatorial air which has travelled for a long distance over the sea, consequently there is an increase of rainfall. The change from summer to winter monsoon in autumn is marked by a warm spell in September, the " old wives summer."

The changes in wind direction, temperature, humidity, cloudiness and rainfall associated with the European monsoon are worked out in great detail with the aid of five-day means for a number of places, generally based on averages for periods of twenty years. Some well-marked individual cases are investigated by means of synoptic charts. The author recognises that there are often great irregularities in individual years, and that the " European monsoon " is only a secondary factor, but claims that its part in the determination of the sequence of weather changes is not without importance.

Beitrag zur Langfrist-Wettervorhersage. By F. B. Groissmayr. Ann. Hydrogr. Berlin, 1928, pp. 287-93 and 310-7.

The main interest of this pair of papers is the influence of Charleston rainfall on world weather, and I have prepared a note which follows in criticism. The following are some of the coefficients which Prof. Groissmayr gets with Charleston rainfall :— + 0·64 with Charleston rain next year, + 0·61 with the Nile 2 years later, – 0·66 with Azores-Iceland pressure December to February 2½ years later, in each case based on about 50 years of data. He also connects the autumn temperature of the eastern United States with Argentine pressure in May preceding.

Note on Charleston Rainfall and its Relation to World Weather.—In view of the surprisingly large coefficients obtained by Prof. Groissmayr with a single raingauge at Charleston it seemed advisable to try whether the results would be equally shown by the rainfall indicated by the raingauges of the neighbourhood. From the *Summaries of Climatological Data by Sections** I selected a number of such stations and correlated their rainfall with the Nile 2 years later as follows :—Hatteras 0·42, Pinopolis 0·24, Savannah 0·36, Wilmington 0·40 : further, the mean of the seven stations Jacksonville, Savannah, Augusta, Southport, Wilmington, Charlotte and Pinopolis gave the coefficient 0·42 with 50 years of data. It may be concluded, therefore, that the relationship 0·60 with Charleston is fictitiously big.

Another test may be applied by extending the data still further back and a graphical comparison of the period 1834-1870 does not show a particularly close relationship.

It is also of interest to correlate with the Nile at intervals other than that of 2 years chosen by Prof. Groissmayr. With Carolina rainfall and the Nile of the same year the coefficient is 0·20, with the Nile one year later 0·34, 2 years later 0·42, 3 years later 0·42 and 4 years later 0·28, so that there is a good deal of persistence probably due to slow changes common to both factors.

The above tests were made at the suggestion of Sir Gilbert Walker.

E. W. Bliss.

---

* *Washington. Bulletin W. 2nd edition,* 1926.

Books Received

Zur Bedeutung des Voltaeffektes für Raumladungsmessungen nach der Thomson'schen Methode. By F. Lindholm and M. Bider (Helvetica Physica Acta. Vol. I, Fas. 9).

Bibliography of Meteorological Papers in the publications of the Asiatic Society of Bengál, 1788-1928. By V. V. Sohoni, Jour. and Proc. Asiatic Soc., Bengal. (New Series), XXIII, 1927, No. 3.

News in Brief

The Council of the Royal Society of Arts has awarded, the prize of £150 which they offered in 1929 under the Thomas Gray Memorial Trust for an improvement in the science or practice of navigation, to Dr. A. T. Doodson, Associate Director of the Liverpool Observatory and Tidal Institute for his work on the analysis and prediction of tidal currents.

According to *The Times* an Arctic expedition, under the leadership of Professor Alfred Wegener of Graz University, has left Berlin for Greenland, where it is proposed to spend some 18 months exploring the interior.

The Weather of March, 1930

The weather of March was very variable, generally mild and cloudy at first, then cold and snowy, and finally mild and sunny. Fine warm sunny anticyclonic conditions prevailed for the first two days of the month, and temperature rose generally to above 50°F., reaching 55°F. at Fort Augustus and Kilmarnock on the 1st and 61°F. at Tottenham on the 3rd. There was much mist or fog locally in the mornings and evenings. Fair conditions prevailed in the eastern districts for some time after this, but a shallow depression centred off our south-west coasts brought rain in the west on the 4th, which spread north later. On the 6th a trough of low pressure passed eastwards across the country and rain was general. Among the heaviest falls were 1·17in. at Tyn-y-waun (Glamorgan) on the 6th and 0·72in. at Rothesay on the 5th. Mild anticyclonic conditions were re-established on the 7th and 8th, except in the extreme north. On the 9th a complete change occurred; the large area of low pressure (with several centres) over northern Europe and Greenland extended southwards over the British Isles, and the air supply over this country was derived from the Arctic. Cold, unsettled wintry weather prevailed with rain, sleet and snow at times. Heavy snow was general over Scotland, north Ireland and north England from the 10th to 23rd, and also occurred in south England on the 19th and 20th, 4in. were measured at Durham on the 16th, 5in. at Rhayader on the 19th, and 9in. at Aspatria on the 18th. Precipitation measurements were heaviest on the 14th, 15th, 16th and 19th, *e.g.*, 1·30in. at Goytre Hall (Monmouth) on the 14th and 1·31in. at Barnsley (Yorkshire) on the 15th. Night temperatures in the screen were frequently below 30°F. and as low as 12°F. at Eskdalemuir on the 20th, while ground minima fell to 10°F. at Armagh on the 19th and 3°F. at Ross-on-Wye on the 20th. Day temperatures did not rise above 32°F. in parts of north Scotland and the English Midlands on the 19th. The 22nd was a very sunny day, over 10hrs. bright sunshine being recorded locally, but the 23rd was again wet in the south. By the evening of the 23rd warm southwesterly winds in the rear of a ridge of high pressure reached Ireland. The warmth spread north and east, reaching southeast England on the 25th, but the snow had not disappeared from Scotland until the 26th. The weather continued warm until the end of the month, but during the last few days deep depressions on the Atlantic moving northeast caused moderate rain locally on a few days and gales at exposed places on our western coasts on the 28th. The 24th, 26th and 29th, however, were very sunny days, 11·1hrs. of bright sunshine being recorded at Plymouth on the 26th and at Oxford on the 29th. The total rainfall for the month was above normal, except in north Scotland and south and east England. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs).
Stornoway	122	+17	Liverpool	98	—10
Aberdeen	141	+24	Ross-on-Wye	104	—12
Dublin	99	—24	Falmouth	132	— 6
Birr Castle	86	—24	Gorleston	133	— 2
Valentia	105	—18	Kew	122	+17

Pressure was below normal over the North Atlantic and western Europe, except for the Iberian Peninsula, Italy and Iceland, the greatest deficit being 7·1mb. at Rost and the greatest excesses 6·2mb. at Isafjord and 2·6mb. at Madrid. Temperature was above normal generally over western Europe, being as much as 5°F. in excess in southern Norrland and eastern Svealand, but below normal in Scotland, Ireland and Spitsbergen. Precipitation was in excess over the northern part of Scandinavia being twice the normal in Lapland but deficient in Spitsbergen and central Europe.

High temperatures were experienced in south Iceland during the beginning of the month, 55°F. being registered at Seydisfjord at 18h. on the 1st. The river Hvita overflowed its banks on the 3rd, inundating a large area of the Floi Lowlands. The floods had passed their peak by the 5th, but the roads were impassable for several days. As a result of the heavy rain and relatively high temperature severe floods were experienced in south France during the first half of the month.* These were subsiding after the 6th, but heavy rain in southwest France about the 12th extended the flood area to the Bayonne district. The floods continued to spread slightly until about the 19th, when they had mostly disappeared. In all 206 people were drowned. Warm rain having melted the snow on the south side of the Pyrenees, the Ebro rose 20ft. above its normal level on the 14th. The peak of the flood reached Saragossa at 6h. on the 15th. Many cattle were lost. A strong Föhn wind which arose after violent thunderstorms on the 15th swept across Switzerland, causing widespread damage and many avalanches. Snow fell heavily all over Switzerland on the 19th, reaching a depth of nearly 2ft. at a level of 4,000ft.

The floods in the desert in Western Australia continued until about the 4th. Heavy monsoon rain also fell in central and northern Australia at the beginning of the month. Beneficial rain fell during the month over the north coast, the northern Riverina and the greater part of the wheat belt of New South Wales.

A tornado caused much damage at Los Angeles, California, on the 15th, but there was no loss of life. Cold weather was experienced at the beginning and end of the month in the United States, but between about the 6th and 18th the temperature was generally moderate except in the northeastern districts, where it was exceptionally warm, 70°F. and above being recorded on one or two days at a few places. Rainfall was generally moderate. A severe snowstorm, however, occurred over the area between Nebraska, Pennsylvania, the Great Lakes and the Tennessee mountains on the 26th, 19in. of snow were reported in Chicago. About 400yds. of the Leopoldina railway track and several bridges were washed away at Petropolis near Rio de Janeiro, the result of a severe storm on the 24th, and floods occurred at Selva San Andres on the Pilcomayo, Argentina, on the 26th.

The special message from Brazil states that the rainfall was generally scarce, the average being 0·24in., 0·51in. and 0·75in. below normal in the northern, central and southern regions respectively. Eight anticyclones passed across the country. The crops were generally affected by the lack of rain during the last three months, though cotton was improving with the increased precipitation during the last days of March. At Rio de Janeiro pressure was normal and temperature 1·3°F. above normal.

Rainfall, March, 1930.—General Distribution

England and Wales	102	per cent of the average 1881-1915.
Scotland	78	
Ireland	146	
British Isles	106	

---

* *See Meteorological Magazine* 65 (1930), p. 43.

Rainfall: March, 1930: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square..........	1·60	87	*Leics* .	Belvoir Castle...........	1·58	87
Sur .	Reigate, Alvington.....	2·07	88	*Rut* .	Ridlington...............	1·83	...
Kent .	Tenterden, Ashenden...	1·84	82	*Linc* .	Boston, Skirbeck.......	1·66	106
,, .	Folkestone, Boro. San..	2·49	...	,, .	Cranwell Aerodrome...	2·18	156
,, .	Margate, Cliftonville...	1·77	111	,, .	Skegness, Marine Gdns	1·37	83
,, .	Sevenoaks, Speldhurst	1·88	...	,, .	Louth, Westgate........	1·94	92
Sus .	Patching Farm........	2·01	93	,, .	Brigg, Wrawby St.....	1·72	...
,, .	Brighton, Old Steyne..	1·67	83	*Notts* .	Worksop, Hodsock.....	2·27	134
,,	Heathfield, Barklye....	1·80	72	*Derby* .	Derby, L. M. & S. Rly.	2·83	165
Hants .	Ventnor, Roy. Nat. Hos.	1·38	67	,, .	Buxton, Devon Hos....	2·62	63
,, .	Fordingbridge, Oaklnds	1·36	58	*Ches* .	Runcorn, Weston Pt...	3·24	160
,, .	Ovington Rectory.......	1·44	56	,, .	Nantwich, Dorfold Hall	3·42	...
,, .	Sherborne St. John.....	1·23	55	*Lancs* .	Manchester, Whit. Pk.	2·65	117
Berks .	Wellington College.....	1·09	55	,, .	Stonyhurst College.....	2·85	77
,, .	Newbury, Greenham...	·99	44	,, .	Southport, Hesketh Pk	3·11	139
Herts .	Welwyn Garden City...	1·54	...	,, .	Lancaster, Strathspey	3·14	...
Bucks .	High Wycombe..........	1·57	80	*Yorks* .	Wath-upon-Dearne.....	2·21	127
Oxf . .	Oxford, Mag. College..	1·13	74	,, .	Bradford, Lister Pk....	2·90	119
Nor .	Pitsford, Sedgebrook...	1·79	102	,, .	Oughtershaw Hall......	4·46	...
,, .	Oundle.....................	1·61	...	,, .	Wetherby, Ribston H.	2·45	126
Beds .	Woburn, Crawley Mill	1·65	96	,, .	Hull, Pearson Park.....	1·77	97
Cam .	Cambridge, Bot. Gdns.	1·55	106	,, .	Holme-on-Spalding.....	1·51	...
Essex .	Chelmsford, County Lab	1·24	72	,, .	West Witton, Ivy Ho.	2·76	...
,, .	Lexden Hill House....	1·40	...	,, .	Felixkirk, Mt. St. John	2·77	141
Suff .	Hawkedon Rectory.....	1·36	72	,, .	Pickering, Hungate....	2·15	...
,, .	Haughley House........	1·01	...	,, .	Scarborough.............	2·29	127
Norf .	Norwich, Eaton.........	1·37	72	,, .	Middlesbrough..........	2·82	180
,, .	Wells, Holkham Hall	...	...	,, .	Baldersdale, Hury Res.	2·18	...
,, .	Little Dunham..........	1·46	76	*Durh* .	Ushaw College...........	2·64	120
Wilts .	Devizes, Highclere......	1·97	94	*Nor* .	Newcastle, Town Moor	1·77	84
,, .	Bishops Cannings.......	2·07	92	,, .	Bellingham, Highgreen	...	...
Dor .	Evershot, Melbury Ho.	2·29	77	,, .	Lilburn Tower Gdns....	2·97	...
,, .	Creech Grange..........	1·15	...	*Cumb* .	Geltsdale.................	2·18	...
,, .	Shaftesbury, Abbey Ho.	1·65	70	,, .	Carlisle, Scaleby Hall	2·65	108
Devon .	Plymouth, The Hoe...	2·72	93	,, .	Borrowdale, Seathwaite	6·84	61
,, .	Polapit Tamar...........	2·82	95	,, .	Borrowdale, Rosthwaite	5·68	...
,, .	Ashburton, Druid Ho.	...	...	,, .	Keswick, High Hill.....	2·36	...
,, .	Cullompton.............	2·93	107	*Glam* .	Cardiff, Ely P. Stn.....	2·49	77
,, .	Sidmouth, Sidmount...	2·52	103	,, .	Treherbert, Tynywaun	4·51	...
,, .	Filleigh, Castle Hill....	3·18	...	*Carm* .	Carmarthen Friary.....	3·23	85
,, .	Barnstaple. N. Dev. Ath.	2·97	113	,, .	Llanwrda..................	3·84	83
Corn .	Redruth, Trewirgie.....	3·65	101	*Pemb* .	Haverfordwest, School	3·74	110
,, .	Penzance, Morrab Gdn.	3·69	115	*Card* .	Aberystwyth............	2·51	...
,, .	St. Austell, Trevarna...	4·22	123	,, .	Cardigan, County Sch.	3·20	...
Soms .	Chewton Mendip........	2·59	72	*Brec* .	Crickhowell, Talymaes	3·80	...
,, .	Long Ashton............	2·22	...	*Rad* .	Birm W. W. Tyrmynydd	3·75	70
,, .	Street, Millfield	1·72	...	*Mont* .	Lake Vyrnwy...........	4·83	113
Glos. .	Cirencester, Gwynfa....	2·04	88	*Denb* .	Llangynhafal............	4·36	...
Here .	Ross, Birchlea...........	2·77	136	*Mer* .	Dolgelly, Bryntirion...	3·66	74
,, .	Ledbury, Underdown..	2·61	137	*Carn* .	Llandudno...............	3·20	147
Salop .	Church Stretton.........	3·85	163	,, .	Snowdon, L. Llydaw 9	...	...
,, .	Shifnal, Hatton Grange	3·13	172	*Ang* .	Holyhead, Salt Island	3·73	142
Worc .	Ombersley, Holt Lock	2·15	127	,, .	Lligwy.....................	2·86	...
,, .	Blockley..................	1·86	...	*Isle of Man*			
War .	Farnborough............	2·45	116		Douglas, Boro' Cem....	3·02	102
,, .	Birminghm, Edgbaston	2·69	141	*Guernsey*			
Leics .	Thornton Reservoir....	2·73	148		St. Peter P't. Grange Rd.	2·32	94

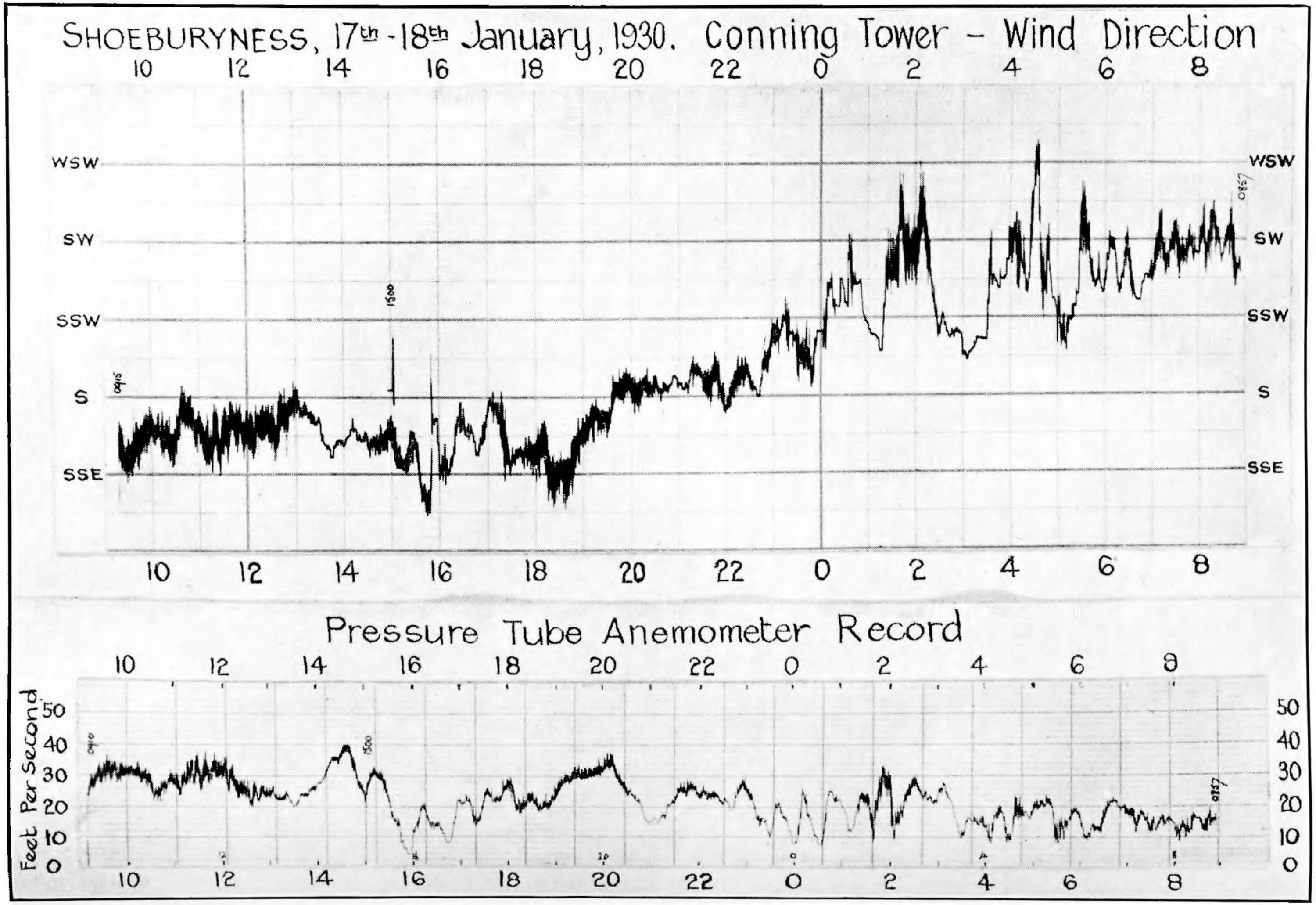
Rainfall: March, 1930: Scotland and Ireland

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Stoneykirk, Ardwell Ho	...	...	*Suth* .	Loch More, Achfary	5·67	88
,, .	Pt. William, Monreith	2·28	...	*Caith* .	Wick	1·60	70
Kirk .	Carsphairn, Shiel	4·92	...	*Ork* .	Pomona, Deerness	1·74	62
,, .	Dumfries, Cargen	3·22	89	*Shet* .	Lerwick	...	...
Dumf .	Eskdalemuir Obs.	3·96	...	*Cork* .	Caheragh Rectory	7·11	...
Roxb .	Branxholm	...	...	,, .	Dunmanway Rectory	7·96	162
Selk .	Ettrick Manse	3·18	...	,, .	Ballinacurra	7·17	252
Peeb .	West Linton	2·22	...	,, .	Glanmire, Lota Lo.	7·18	232
Berk .	Marchmont House	2·35	89	*Kerry* .	Valentia Obsy	6·54	144
Hadd .	North Berwick Res.	1·78	95	,, .	Gearahameen	10·20	...
Midl .	Edinburgh, Roy. Obs.	2·15	120	,, .	Killarney Asylum	...	...
Ayr .	Kilmarnock, Agric. C.	2·35	84	,, .	Darrynane Abbey	6·69	164
,, .	Girvan, Pinmore	3·29	87	*Wat* .	Waterford, Brook Lo.	5·79	210
Renf .	Glasgow, Queen's Pk.	2·56	98	*Tip* .	Nenagh, Cas. Lough	5·01	162
,, .	Greenock, Prospect H.	4·40	90	,, .	Roscrea, Timoney Park	3·79	...
Bute .	Rothesay, Ardencraig.	3·26	91	,, .	Cashel, Ballinamona	5·55	202
,, .	Dougarie Lodge	2·76	...	*Lim* .	Foynes, Coolnanes	3·63	126
Arg .	Ardgour House	6·41	...	,, .	Castleconnel Rec.	4·89	...
,, .	Manse of Glenorchy	5·70	...	*Clare* .	Inagh, Mount Callan	5·34	...
,, .	Oban	3·84	...	,, .	Broadford, Hurdlest'n.	5·53	...
,, .	Poltalloch	3·07	80	*Wexf* .	Newtownbarry	...	...
,, .	Inveraray Castle	5·06	80	,, .	Gorey, Courtown Ho.	5·30	230
,, .	Islay, Eallabus	3·65	95	*Kilk* .	Kilkenny Castle	3·96	173
,, .	Mull, Benmore	7·90	...	*Wic* .	Rathnew, Clonmannon	4·44	...
,, .	Tiree	...	...	*Carl* .	Hacketstown Rectory	5·19	185
Kinr .	Loch Leven Sluice	2·42	81	*Leix* .	Blandsfort House	4·99	190
Perth .	Loch Dhu	6·05	92	,, .	Mountmellick	3·83	...
,, .	Balquhidder, Stronvar	4·64	...	*Off'ly* .	Birr Castle	3·74	156
,, .	Crieff, Strathearn Hyd.	2·24	70	*Dubl* .	Dublin, FitzWm. Sq.	3·19	165
,, .	Blair Castle Gardens	1·30	50	,, .	Balbriggan, Ardgillan.	3·95	196
,, .	Dalnaspidal Lodge	...	...	*Me'th* .	Beauparc, St. Cloud	3·61	...
Angus .	Kettins School.	1·87	85	,, .	Kells, Headfort	3·70	134
,, .	Dundee, E. Necropolis	1·64	80	*W.M* .	Moate, Coolatore	3·80	...
,, .	Pearsie House	1·51	...	,, .	Mullingar, Belvedere.	3·82	141
,, .	Montrose, Sunnyside	1·32	63	*Long* .	Castle Forbes Gdns	4·21	143
Aber .	Braemar, Bank	1·56	52	*Gal* .	Ballynahinch Castle	5·44	106
,, .	Logie Coldstone Sch.	1·07	41	,, .	Galway, Grammar Sch.	3·06	...
,, .	Aberdeen, King's Coll.	1·33	55	*Mayo* .	Mallaranny	4·81	...
,, .	Fyvie Castle	2·30	...	,, .	Westport House	3·17	81
Moray .	Gordon Castle	1·26	54	,, .	Delphi Lodge	7·98	...
,, .	Grantown-on-Spey	...	...	*Sligo* .	Markree Obsy	3·09	89
Nairn .	Nairn, Delnies	1·01	54	*Cav'n* .	Belturbet, Cloverhill	2·76	100
Inv .	Kingussie, The Birches	1·24	...	*Ferm* .	Enniskillen, Portora	2·88	...
,, .	Loch Quoich, Loan	8·51	...	*Arm* .	Armagh Obsy	2·14	91
,, .	Glenquoich	7·02	72	*Down* .	Fofanny Reservoir	5·99	...
,, .	Inverness, Culduthel R.	1·26	...	,, .	Seaforde	2·91	100
,, .	Arisaig, Faire-na-Squir	3·78	...	,, .	Donaghadee, C. Stn	1·65	75
,, .	Fort William	4·80	...	,, .	Banbridge, Milltown	1·97	...
,, .	Skye, Dunvegan	5·12	...	*Antr* .	Belfast, Cavehill Rd	1·95	...
R & C .	Alness, Ardross Cas	1·95	60	,, .	Glenarm Castle	3·01	...
,, .	Ullapool	2·70	...	,, .	Ballymena, Harryville	2·72	86
,, .	Torridon, Bendamph	6·56	87	*Lon* .	Londonderry, Creggan	3·15	98
,, .	Achnashellach	5·04	...	*Tyr* .	Donaghmore	2·41	...
,, .	Stornoway	3·07	75	,, .	Omagh, Edenfel	3·49	111
Suth .	Lairg	1·87	...	*Don* .	Malin Head	2·23	...
,, .	Tongue	3·48	104	,, .	Dunfanaghy	2·81	...
,, .	Melvich	3·05	...	,, .	Killybegs, Rockmount.	4·05	79

Climatological Table for the British Empire, October, 1929.

STATIONS	PRESSURE		TEMPERATURE									PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean	Relative Humidity.	Mean Cloud Am'nt	Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
			Max.	Min.	Max.		max. and min.	Diff. from Normal	Wet Bulb							
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy. ..	1010·5	— 3·5	64	31	56·7	43·2	49·9	0·0	45·3	92	6·3	2·73	+ 0·03	14	3.5	33
Gibraltar............	1017·5	+ 0·3	80	51	73·7	60·3	67·0	+ 0·9	58·8	83	4·3	2·58	— 0·73	6	..	..
Malta	1016·4	— 0·2	80	58	73·2	63·2	68·2	— 2·7	61·5	70	4·1	1·11	— 1·76	7	8·4	74
St. Helena	1014·5	+ 2·1	..	53	..	53·6	..	..	54·5	97	9·8	1·66	— 0·25	22	..	..
Sierra Leone	1013·5	+ 1·9	89	69	85·2	71·9	78·5	— 1·6	75·8	85	4·6	10·69	— 1·93	21	..	..
Lagos, Nigeria	1009·0	— 2·7	89	70	85·6	73·8	79·7	+ 0·2	76·0	83	8·6	6·03	— 1·73	11	..	..
Kaduna, Nigeria	1014·8	+ 2·5	92	..	87·0	..	..	..	71·3	78	1·0	3·47	+ 1·29	11	..	..
Zomba, Nyasaland ..	1009·7	— 1·2	91	59	87·9	66·4	77·1	+ 3·0	..	52	2·8	0·49	— 1·03	3	..	..
Salisbury, Rhodesia ..	1008·1	— 0·5	90	52	85·5	60·3	72·9	+ 2·2	59·4	39	1·8	1·11	— 0·03	5	9·8	78
Cape Town	1019·2	+ 1·8	87	44	70·3	54·2	62·3	+ 1·1	55·7	70	4·2	0·58	— 1·07	6	..	..
Johannesburg........	1013·0	— 0·2	82	50	74·5	55·5	65·0	+ 2·3	56·2	68	4·8	4·17	+ 1·61	15	8·5	67
Mauritius	1017·4	— 0·8	84	61	79·7	64·9	72·3	— 0·4	68·2	65	6·3	0·87	— 0·51	14	7·9	63
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	0·69	— 0·99	..	..	..
Calcutta, Alipore Obsy.	1009·7	+ 0·3	92	68	87·3	74·7	81·0	+ 0·3	75·9	89	3·5	11·51	+ 7·32	10*	..	..
Bombay	1009·9	+ 0·1	95	73	88·9	75·9	82·4	+ 0·1	75·6	83	3·2	4·82	+ 3·15	5*	..	..
Madras	1008·7	— 0·2	97	72	90·0	75·9	82·9	+ 0·6	76·5	83	6·1	6·69	— 5·03	8*	..	..
Colombo, Ceylon	1011·0	+ 0·7	87	71	85·5	74·5	80·0	— 0·3	76·8	75	6·8	4·74	— 8·38	19	8·0	67
Hongkong	1014·1	+ 0·5	86	69	80·6	73·2	76·9	0·0	69·9	66	3·7	0·14	— 4·71	4	9·3	80
Sandakan	..	..	90	72	87·7	74·5	81·1	— 0·4	77·5	84	..	15·01	+ 5·01	19	..	..
Sydney, N.S.W.	1015·7	+ 0·8	86	47	68·2	55·7	61·9	— 1·6	57·4	66	5·9	9·13	+ 5·92	14	6·9	55
Melbourne	..	..	83	42	66·4	50·3	58·3	+ 0·7	51·5	60	6·6	2·82	+ 0·23	15	5·1	39
Adelaide	1017·9	+ 1·9	92	43	71·7	50·7	61·2	— 0·7	53·3	51	6·6	1·03	— 0·71	10	8·3	64
Perth, W. Australia ..	1016·6	— 0·2	85	42	71·3	52·1	61·7	+ 0·7	54·6	57	5·6	1·09	— 1·09	9	8·2	64
Coolgardie	1015·2	0·0	94	39	78·7	50·1	64·4	+ 0·8	51·5	33	2·3	1·37	+ 0·63	3	..	..
Brisbane	1015·7	— 0·5	88	53	78·9	59·5	69·2	— 0·6	61·8	57	4·9	2·58	+ 0·01	10	8·4	66
Hobart, Tasmania....	1013·7	+ 3·1	75	38	61·1	47·0	54·1	+ 0·1	48·7	66	8·0	1·48	— 0·78	17	5·1	39
Wellington, N.Z.	1018·7	+ 5·6	66	38	58·5	46·7	52·6	— 1·7	50·3	75	7·0	2·24	— 1·84	13	6·2	47
Suva, Fiji	1013·6	+ 0·4	84	65	81·6	71·0	76·3	+ 0·3	72·4	79	7·3	10·85	+ 3·05	13	5·2	42
Apia, Samoa	1010·8	— 0·7	88	71	84·7	74·3	79·5	+ 1·1	76·9	79	5·0	12·58	+ 6·52	19	6·6	53
Kingston, Jamaica....	1011·4	— 0·1	90	69	86·8	72·4	79·6	— 0·9	71·6	88	4·9	4·96	— 2·50	11	6·7	57
Grenada, W.I.	1009·0	— 1·6	90	72	87·6	74·5	81·1	+ 1·0	74·9	71	4·1	9·49	+ 1·84	16	..	..
Toronto	1017·0	— 1·0	72	28	55·8	41·1	48·5	+ 1·6	42·1	74	7·2	2·29	— 0·17	8	4·0	36
Winnipeg	1018·3	+ 3·0	78	19	55·2	36·1	45·7	+ 4.9	37·3	96	5·0	0·90	— 0·53	6	4·7	44
St. John, N.B.	1014·9	— 1·6	65	25	52·7	40·1	46·4	+ 1·1	43·4	83	6·6	5·37	+ 0·83	12	4·1	37
Victoria, B.C.	1019·1	+ 1·5	67	41	58·8	47·7	53·3	+ 2·9	50·2	83	6·1	1·23	— 1·32	14	4·6	42

For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.



SHOEBURYNESS, 17th-18th January, 1930. Conning Tower - Wind Direction

Pressure Tube Anemometer Record

WIND RECORDS, SHOEBURYNESS, JANUARY 17TH-18TH, 1930—(*see* p. 92).

M.O. 326.

The Meteorological Magazine

Vol. 65
May 1930
No. 772

Air Ministry :: Meteorological Office

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH; YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 15, DONEGALL SQUARE WEST, BELFAST; or through any Bookseller.

On the Design of Raingauges for Tropical Use

By A. J. BAMFORD, M.C., M.A., B.Sc.

One of the items submitted for consideration by the recent International Conference at Copenhagen was a suggestion that it was desirable to standardise a definite form of raingauge for universal use. The implied idea that uniformity of apparatus will give comparable results in different parts of the world is at first sight a natural one. However, what we really want is comparable observations, and I submit that in order to obtain these in different parts of the world, under the very different conditions that exist, what is required is not uniformity of apparatus, but suitable variations in apparatus, to meet the various difficulties that arise under different conditions.

In a letter to the *Meteorological Magazine* in October, 1922,* I made the point that the standard 5in. gauge approved by the Meteorological Office as the most suitable for use in England underestimated in Ceylon—and I suspect would underestimate in most tropical climates. In that letter I supported my argument by figures from a number of gauges here over a period of several months, and attributed the deficit chiefly to evaporation. Comparative observations of eleven gauges have been maintained here for the last six years, so that I can now amplify the previous figures.

The standard rainfall is taken to be that from a specially

---

* Vol. 57, 1922, p. 240.

(89474) P.S. 14/89 1,050 5/30 M. & S. *Gp.303*

protected 8in. copper gauge with deep lip and two inner receivers, in addition to the outer cover, which itself acts as receiver if both the inner ones overflow. This outer cover is a copper cylinder of 8in. diameter. The inner receivers consist of a metal cylinder of 5in. diameter, and within it a graduated glass which overflows when the rainfall exceeds 0·65in. The rim of this gauge is 21in. above ground level and a mild windscreen is provided by its being enclosed by a fence 3 feet in height, consisting of wire netting (½in. mesh) on a wooden framework. The width of the enclosure is 14 feet. This gauge has the advantage of being read three times daily, so that in no case can water stand in it for longer than 15 hours. The close agreement between its figures and those of the self-recording (Richard) gauge is striking, but will not be discussed further here.

The main discussion in this paper turns on the relationship between the figures of six similarly situated gauges which are read only once daily. These six gauges have rims of 5in. diameter, and are arranged in line on open level ground at intervals of six feet with their rims 12in. above ground level. Of these the 1st, 3rd and 5th are of the standard London Meteorological Office type with buried conical base and metal cylindrical containers of diameter 4¾in. The inside of their funnels commences with a vertical drop of 5in., after which the cone slopes to a total depth of 7in. below the rim. These gauges are referred to below as of " M.O." type. The middle one of them has in addition a glass bottle receiver of diameter 5in. tapering to a narrow neck, which is only just large enough to receive the central vertical tube from the funnel. The 2nd, 4th and 6th gauges have funnels of the British Association type (abbreviated below to " B.A."), *i.e.*, a slope of 45° commences less than half an inch below the rim, and the 2nd and 6th have the ordinary B.A. receivers—metal cylinders of diameter 2½in. The middle one, No. 4, has a bottle similar to that in No. 3—the difference being that whereas in the case of No. 3 the bottle is in addition to the metal receiver, in the B.A. gauge it is instead of it.

Starting from the generally accepted ideas that the shallow funnel of a B.A. gauge will lose a little owing to splash, when compared with the deep lip of the M.O. standard, and that any gauge tends to underestimate if the altitude of its rim above the ground is increased, we might expect the M.O. gauges at one foot altitude to record most. The experimental facts do not follow this expectation, and as there appears to be no reason why the accepted variations due to splash and wind eddies should not be in operation here, I attribute the discrepancy between the expectation based on those causes alone and the experimental facts, to the existence of additional distorting causes, notably evaporation.

The standard 8in. gauge has the highest figures throughout, and in the table below the amounts recorded by other gauges are expressed as deficits below this amount. Looking at the grand totals first, it will be seen that on days of low rainfall (*i.e.*, less than 0·2in. or 5mm.) the M.O. gauges show an average deficit of 9 per cent., which is more than 2 per cent. greater deficit than the B.A. gauges, whose figure is 6·9 per cent. The gauges with glass receivers recorded greater amounts than those without, but again the M.O. gauge recorded less than the B.A. one, though by a smaller amount than in the previous case. This may be expressed otherwise by saying that the effect of the bottle receiver is greater in the case of the M.O. gauge, where it constitutes an addition, than in the case of the B.A. gauge, where it is simply an alternative, and where the original form does not leave so much room for improvement.

Looking next at falls of from 0·2in. to 1·0in. in 24 hours, we find that the percentage deficits are lower, but again the unmodified M.O. gauges lose more than the B.A. ones. The effect of the bottle under the B.A. rim is less than 0·1 per cent., but under the M.O. rim it is considerable and gives the smallest deficit of the whole set.

In the case of rainfalls above 1in. we cannot expect the same accuracy. An observer who could make repeated measurements of, say, 6in. using a ½in. glass, and never deviate by 0·01in. from the truth would be superhuman. For comparisons, however, we can accept six-year summaries without compunction, and the most striking thing is the lack of variation between the different gauges. With falls of over 1in. the atmospheric humidity will in general be high, liability to evaporation is less, and instrumental precautions to prevent it, that were necessary in other cases, are no longer so important. Under B.A. rims the difference between metal and glass receivers is inappreciable. Under the M.O. ones the glass receiver actually loses the most, suggesting that evaporation from the stored rain in the receiver is unimportant in this case. All the B.A. rims show less than the M.O. ones, presumably because of loss by splash, which had been masked by the evaporation effects in the case of smaller falls. It may be noted here that falls of small amount are frequently intense so far as rate of fall is concerned, so that it is unlikely that the percentage effect of splash is much greater in the case of large ones.

An incidental comment on the loss by evaporation in Ceylon is supplied by the self-recording gauges. When no rain falls, their pens draw horizontal lines at heights depending on the amount of water left in the cylinders. When an appreciable drought occurs this line gradually sinks on the charts of successive days, despite the fact that the float covers nearly all the water surface and the air in the upper part of the cylinder is stagnant. The amount of this sinkage averages about 0·025in. in a dry fortnight. The numerical result does not admit of exact interpretation, as it depends on the small amount of clearance round the float, but the fact that the loss is a measurable quantity is significant.

Thus far the discussion has been essentially on the lines of my previous letter in 1922, amplified by the longer period of observation, and the greater variety of receivers, but a further point may be considered. Instead of referring to deficits as percentages of total falls we can divide them by the number of days with rain and express them as mean deficits per observation, and here we come up against a further point with regard to the evaporation.

If we think of the loss from the collected water in a cylindrical container, the evaporating surface will be of the same extent whether the container is a quarter full, or three-quarters full. It will only be reduced if the amount of rain is insufficient to cover the whole base. If we consider this cause alone, we might expect the loss per observation to increase slightly with increased amounts of rainfall up to what is necessary to cover the whole base of the receiver, and then remain constant. Allowing for the fact that the atmosphere will in general be drier on days of little rain, we must superimpose on the above a tendency for greater loss per observation on the days of less rainfall. However, when we examine the actual deficits we find that while rainfalls of less than 0·2in. per day show a mean loss of from ·004in. to ·005in. per observation, this amount goes up to about ·010in. for the stage from 0·2in. to 1·0in. (5 to 25mm.), and to ·016in.-·018in. for the heavy falls, although the cross section of the receiver is unaltered throughout in the case of M.O. receivers, and only increases in the two outer B.A. ones when over 2¼in. have fallen. The increase does not appear to be due to direct error in the diameters of the gauges, since such an error would vary directly with the amount measured.

Thus both types show deficits, apparently due to evaporation, whose amounts per observation increase slightly with the quantity of rain, and which cannot be explained by evaporation from the water at rest in the container. This loss presumably takes place while the water is on the surface of the funnel, and in the down pipe. Clearly water does not remain for long on the surface of the funnel, but while it is there, it is spread in a thin film peculiarly susceptible to evaporation, and all the time rain is falling, the funnel has a thin film of water over it.

The deep-lipped funnel thus encourages evaporation by the mere fact that the rain has a longer journey over its surface than in the case of the shallow one. But this is not all. Rain normally reaches the earth at Colombo at a lower temperature than that of the gauge it encounters.* Consider two funnels of similar design but of different thickness. The thicker one will have higher heat capacity and will take longer to cool down under the effect of the rain. During this process it will stimulate evaporation more than the lighter one. The deep lipped M.O. gauge has a vertical drop of 5in. before the sloping part of the funnel commences. The whole surface that is liable to be wet is over 100 sq. in., or about three times that of the shallow B.A. gauge. With rain falling obliquely half this area may not be wet, but even so the M.O. funnel would have a wet surface of more than half an much again as the B.A. one. This is certainly not an overestimate because one special asset, rightly claimed for the deep lip, is that it saves loss by splash, and if this saving is appreciable it means that the part of the inner surface of the funnel that is sheltered from directly falling oblique rain will yet be wet from splash. We have thus the fact that, so long as rain is in progress, both gauges provide a possible evaporating surface of greater extent than that of the still water in the receiver, and that this area is considerably greater in the M.O. gauge than it is in the B.A. one.

---

* Measurements of rain temperatures have been made at Colombo for about three years.

In the temperate zone loss due to this point is probably trivial, but a brief consideration of the quantities concerned shows that it may be expected to be appreciable here. The average evaporation as measured at Colombo is over 80in. per year (Hann puts it as 2-3 metres as a tropical generalisation!) and though evaporation is not working at this rate during heavy rain, the comparison with the English figures of less than 20in. is enough to support the idea of evaporation being altogether a more serious factor here.

It will be seen from the table that the deficits in the south-west monsoon are consistently less than those at other times of year. At first sight we may explain this by saying that the humidity is apt to be higher then, but a further point can be made from it, regarding the importance of evaporation from the funnel compared to that from the receiver. In the south-west monsoon rain may occur at any hour of the day, and on occasions water may have to stand in the container for nearly 24 hours. At other times of year there is very little rain between 8 a.m. and 4 p.m., and hence there is seldom opportunity for evaporation during the worst heat of the day. A faulty container therefore appears to have more scope during the south-west monsoon than at other periods.

Consider now losses from the surface of the funnel. Rain coming during the north-east monsoon, or inter-monsoon thunderstorms, may fall in the afternoon on to a gauge that has been standing in bright sunshine through the heat of the day and which, a few minutes before the rain commenced, was unpleasantly hot to touch. If rain occurred at the same hour during the south-west monsoon, the gauge would probably have been standing under a cloudy sky for several hours previously, and the humidity of the surface air would be high. Thus while evaporation from the funnel is postulated whenever the funnel is wet, we should expect evaporation losses due to faulty funnels to be relatively less marked in the south-west monsoon, and reference to the table shows this to be the case.

		No. of Observations.	Amount Standard Gauge.	Deficits in gauges at 12in.			
				M.O.	M.O. + bottle	B.A.	B.A. + bottle.
Falls of less than 0·2in.							
	S.W. Monsoon ...	298	19·59	1·62	1·06	1·39	·96
	N.E. & Inter-Monsoon	277	17·18	1·70	1·24	1·13	1·14
	All	575	36·77	3·32	2·30	2·52	2·10
Percentage loss	S.W. Monsoon ...	—	—	8·3	5·4	7·1	4·9
	N.E. & Inter-Monsoon	—	—	9·9	7·2	6·6	6·6
	All	—	—	9·0	6·3	6·9	5·7
Loss per Observation	S.W. Monsoon ...	—	—	·0054	·0036	·0047	·0032
	N.E. & Inter-Monsoon	—	—	·0061	·0045	·0041	·0041
	All	—	—	·0058	·0040	·0044	·0037
Falls of from 0·2in. to 1·0in. ...							
	S.W. Monsoon ...	186	88·76	1·90	1·07	1·76	1·44
	N.E. & Inter-Monsoon	217	111·42	2·62	2·23	2·12	2·32
	All	403	200·18	4·52	3·30	3·88	3·76
Percentage loss	S.W. Monsoon ...	—	—	2·1	1·2	2·0	1·6
	N.E. & Inter-Monsoon	—	—	2·4	2·0	1·9	2·1
	All	—	—	2·3	1·6	1·9	1·9
Loss per Observation	S.W. Monsoon ...	—	—	·0102	·0058	·0095	·0077
	N.E. & Inter-Monsoon	—	—	·0121	·0103	·0098	·0107
	All	—	—	·0112	·0082	·0096	·0093
Falls of less than 1in.							
	S.W. Monsoon ...	82	168·49	1·20	1·25	1·31	1·21
	N.E. & Inter-Monsoon	109	212·00	1·82	2·02	2·11	2·19
	All	191	380·49	3·02	3·27	3·42	3·40
Percentage loss	S.W. Monsoon ...	—	—	0·7	0·7	0·8	0·7
	N.E. & Inter-Monsoon	—	—	0·9	1·0	1·0	1·0
	All	—	—	0·8	0·9	0·9	0·9
Loss per Observation	S.W. Monsoon ...	—	—	·0146	·0153	·0160	·0148
	N.E. & Inter-Monsoon	—	—	·0167	·0185	·0194	·0201
	All	—	—	·0158	·0171	·0179	·0178

It must be remembered that the Observatory standard gauge, though specially made, and emptied three times a day (which is a precaution not possible at every outstation) must lose something by evaporation from the funnel. The deficits plotted are only the excess of deficit in the case of small gauges, with relatively high heat capacities. As explained above, this does not prevent the comparison between them being rigid.

The principle that in tropical raingauges all unnecessary metal in the funnel is to be avoided receives practical support from another very prosaic source. Quite apart from meteorological considerations a stout copper gauge at a lonely outstation invites theft even more than a cheaper one does! Probably most tropical services will have to depend for some of their rainfall figures on stations where this risk occurs, and at least some of the gauges must have a hasp, padlock and chain. This at once suggests rivets which are anathema—but the lesser of two evils.

Summary.

The suggestion is that to guard against evaporation the ideal funnel for a tropical gauge should have as small a surface, and be of as light weight (low heat capacity) as possible. In practice the surface area cannot be cut down beyond what is necessary to guard against splash, nor the weight below reasonable strength. In passing it is worth noting the corollary. All metal gauges underestimate slightly in the tropics.

Of standard types the English M.O. (which is a snowgauge as well as a raingauge) has a greater surface and heat capacity than is necessitated by these limits, and the B.A. one is preferable. However, where gauges are made locally and dimensions are at choice, I prefer a slightly deeper funnel than the B.A. type as an anti-splash precaution.

2. Open containers of cross section approximating to that of the rim of the funnel allow unnecessary loss by evaporation. This loss can be reduced by supplementing them by inner containers, consisting either of metal cylinders of smaller section, or glass bottles. In experiments at a fixed Observatory under close observation there is little to choose between them, but for outstation use the small metal receiver is probably better, owing to the risk of glass receivers getting broken.

3. A certain proportion of the gauges will require a hasp, padlock and chain. Dangers arising thereby from rivets must be accepted, and guarded against by inspection.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, March 16th, at 49, Cromwell Road, South Kensington, Mr. R. G. K. Lempfert, C.B.E., M.A., F.Inst.P., President, in the Chair.

S. K. Banerji, D.Sc.—The electric field of overhead thunderclouds.

Changes in the electric field produced by eighteen thunderclouds during their passage over the Colaba Observatory in 1929 are discussed in the paper, and these suggest that the majority of them were of the " unitary type " and had their front part negatively charged, the central part positively charged, and the rear negatively charged. A few were of the " double type " and produced changes in the field as if two thunderclouds of unitary type had passed over in succession. In those thunderclouds which caused heavy rainfall, fluctuations in the central positive field, sometimes very rapid and violent, were found to occur on account of loss of charge by rainfall or increased concentration of positive charge owing to increased vertical current, in agreement with the breaking-drop theory.

The monsoon clouds produced an electric field, which was pre-eminently negative during periods of rainfall. The observations appear to support the breaking-drop theory of the origin of electricity in non-thunderstorm rain.

F. J. W. Whipple, Sc.D.—The great Siberian meteor and the waves seismic and aerial which it produced.

On June 30th, 1908, a great meteor fell in Siberia, probably the greatest meteor which has occurred in historic times. The blast of air produced by the meteor devastated the forests over an enormous area. A Russian scientist, Leonard Kulik, explored the region in 1927 and found the numerous holes in which, it is presumed, the fragments of the original meteor are buried.

Although the descriptions of eye-witnesses are very vague, the time at which the meteor fell can be determined accurately, for the impact of the meteorites caused seismic waves which were recorded at four observatories. The most distant of these observatories was Jena. Remarkable waves recorded by sensitive barographs in England on June 30th, 1908, were discussed by Dr. W. N. Shaw at the time; the coincidence of date was noticed by Mr. C. J. P. Cave in 1929, and it is now clear that the air waves were produced by the meteor. The waves took five hours to travel from Siberia to England, the velocity being a little greater than that of the waves due to the famous eruption of Krakatoa.

In a written contribution to the discussion of Dr. Whipple's paper, Mr. Spencer Russell recalled the unusual sunset effects which were observed on the continent and in England on June 30th, 1908, and the succeeding nights. As seen from Epsom the northern sky was of a suffused red hue varying from pink to an intense crimson. On the night of July 1st and July 2nd, twilight was prolonged to daybreak and there was no real darkness.

Erratum

April 1930, page 62, Table I, at head of last column *for* "T_I''" *read* "T_{II}''."

Correspondence

To the Editor, *The Meteorological Magazine.*

Drifting of London Fog

On Easter Sunday, April 20th, I observed here (39 miles from London) what I believe to be patches of London fog carried away by a wind of small velocity. The afternoon was very dark and rain, sleet or hail fell continuously for more than seven hours from 12h. 8m. G.M.T. At 12h. 40m. the darkness became intense and the precipitation became heavier. The most interesting feature was the peculiar yellow light which suffused the sky and caused terrestrial objects to take on an unusual tint. This continued until 13h. 15m. when the light became normal, although the gloom persisted. At 14h. 40m. the phenomenon was repeated. The darkness was greatest and precipitation heaviest at the time when the yellow colour was strongest. The colour was not of uniform intensity over the whole sky. The cloud direction was easterly, but the motion was almost imperceptible. A dead calm lasted for six hours after midday, a most unusual occurrence here. The yellow colour was exactly that of a London fog and the observations have led me to conclude that a patch of high fog over London had been detached and carried away, the velocity of the wind being too small for rapid dispersion of the fog. We are 661 feet above sea level here. I can recall a similar occurrence in the spring of 1920. It would be interesting to hear whether others at a similar distance from London have seen this phenomenon.

S. E. Ashmore.

Windwhistle Cottage, Grayshott, Hindhead, Surrey, April 24*th,* 1930.

Early Weather Record

In view of the recent establishment of an observing and forecasting centre at Cardington Airship Base, the following letter, published in Vol. LIV of the *Philosophical Transactions of the Royal Society,* may be of interest to your readers:—

"An account of the degree of cold observed in Bedfordshire, by John Howard, F.R.S., in a letter to John Canton, M.A., F.R.S., read April 12th, 1764."

> Sir,
>
> I would beg leave to acquaint you of a degree of cold that I observed at Cardington, Bedfordshire, the 22nd of November last, just before sunrise; Fahrenheit's scale, by one of Bird's thermometers, being as low as ten and a half. If it will throw any light upon the locality of cold, or think it worth the society's observation, would leave to your better judgement, and remain, with great esteem, Sir,
>
> Your obedient Servant,
>
> John Howard.

John Howard's meteorological zeal is further evidenced in the

16th volume of *The Gentleman's Magazine* which states " On the frost setting in, he used, during the continuance, to leave his bed at two every morning for the purpose of observing the state of a thermometer which was placed in his garden at some distance from his house," while in a letter dated April 9th, 1786, written at Malta to a maternal relative, Mr. Tatnell, John Howard says: ". . . . We lay by contrary winds several days close to Messina, Catonia, Syracuse, etc., and saw the dreadful effects of the earthquake about two years ago in Sicily. Soon after we met a sad storm, but happy for us, it lasted only four hours and we arrived here about ten days ago. . . . ."

A perusal of John Howard's biography indicates that he collected the data for prison reform, with which he was so closely connected, with great care, and it is therefore probable that his meteorological observations were similarly noted. If still in existence they would be of considerable interest, but though preliminary inquiries have not yet been successful, further attempts to trace the records are being made.

W. A. L. MARSHALL.

Royal Airship Works, Cardington. February 24th, 1930.

[A brief search in the libraries of the Meteorological Office and R. Meteor. Soc. failed to find Mr. John Howard's records.—Ed. *M.M.*]

Weather Lore of Normandy

A glance through a recent publication (Folk tales of Normandy, W. Branch Johnson, Chapman and Hall, 1929) reveals many interesting items dealing with weather lore. A few are given below.

Fishermen used to say that the winds dwelt in a great palace like the children of Aeolus in Homer. A popular name for the wind is Bonhomme Hardy—he who likes to go about opening windows by force. The patron saint of the wind is St. Antoine, whose aid used to be invoked by the sailors of the Pays de Caux in a curious manner—they used to plunge into the sea reciting a sort of prayer; when they wished the wind to abate they would sing soothing lullabies to the Saint. The whole proceeding has rather a magical flavour.

There is a Sussex saying that when it snows " they are plucking geese in Scotland," but this pales before the reason given by the folk of the Bay of Mont-St. Michel :—" the good God is plucking His geese to prepare them for the marriage of His daughters at Easter."

Apparently the Normans retain some fragments of the beliefs of their Norse forbears, for instance, the Norsemen said the rainbow was a bridge joining heaven and earth, the modern Normans say it is the shadow of such a bridge. It is difficult, however, to account for the idea held by sailors that the rainbow sucks up water from the sea, and should a boat happen to sail through the spot where the rainbow touches the sea, it, too, is in danger of being sucked up, as, it is said, has happened. One suspects occasions where a rainbow has been observed by sailors on a small localised thunder-shower (with perhaps a waterspout) when a boat has been wrecked. In such circumstances a boat in or near the shower might be seen by watchers at a distance to be at the foot of the rainbow.

As in other parts of France priests are believed to have power over the elements, one priest in Lower Normandy going by the name of the Cloud Splitter. These powers are also shared by witches and shepherds, and many are the tales told by the peasants.

A poetic idea is that in the lightning the Blessed Virgin may sometimes be seen—also when a sudden light breaks through a storm cloud. Another strange notion, the origin of which is rather obscure, is that when a Pope dies, a cloud is said to bow before the cardinal whom Heaven has chosen to succeed the dead Pontiff.

CICELY M. BOTLEY.

Guildables, 17, Holmesdale Gardens, Hastings, December 21st, 1929.

NOTES AND QUERIES

"Gliding Surfaces" and Fog Formation

The interesting note from Mr. J. Durward in the April number of the magazine, dealing with fog formation in Egypt, raises certain theoretical points of some difficulty. Suppose we have a sloping surface of discontinuity, with the colder air below it, cutting the earth's surface to form a "front" roughly parallel to the isobars. Then it can readily be shown (either directly or from a formula of Margules) that the higher pressure and the steeper pressure gradient lie on the same side of the front, whether the air on that side is cold or warm. This condition is not satisfied on the isobaric chart accompanying Mr. Durward's note. It may also be noted that the centre of the anticyclone was nearer to Ismailia, where there was a calm, than to Heliopolis, where there was a wind of force 5.

The presence of sloping inversions in anticyclones has often been pointed out by Dr. Georgii and others, but the existence of downward sliding of the warm air relative to the cold air has never been proved. In the case of sluggish anticyclones such a process presents very formidable theoretical difficulties. A possible alternative explanation of the observed facts is a slow subsidence of both the cold and the warm air masses, varying somewhat with locality. This should be considered in conjunction with turbulence, radiation, horizontal movements, temperature, and humidity, including condensation and evaporation. All these factors react on each other in a complex manner, and there are few problems in synoptic meteorology in which it is legitimate to ignore any of them.

Patches of cold fog lying close to warm dry air are frequently observed in suitable conditions in England, and there is a marked tendency for calms and light winds in the foggy regions, owing to the smaller lapse rate and the correspondingly smaller amount of turbulence. These conditions are not necessarily associated with sloping surfaces of discontinuity.

C. K. M. DOUGLAS.

Rhythmic Changes in Air Movement

Vol. 57, No. 673, of the *Meteorological Magazine* contains reproductions of the wind, pressure, and temperature records obtained at Southport on January 11th, 1907, together with some remarks by Mr. J. Baxendell on their periodic character. Wind records showing similar features were obtained at Shoeburyness during the 24 hour period commencing at 9h. on January 17th, 1930, photographs of which appear as the frontispiece of this number of the magazine. The instruments used are a Baxendell recorder for wind direction, and a Dines anemograph for wind speed. The other autographic instruments in use at Shoeburyness are not sufficiently sensitive to warrant the inclusion of reproductions of the records given by them during the same period.

The wind records, unlike those of Southport, exhibit variations whose periodic nature is much more strongly marked as regards speed than direction, the effect being enhanced by the exceptionally small gustiness prevailing at the time. This is due in part, no doubt, to the peculiarities of the site of the Shoeburyness anemograph, the head of which is 100ft. above mean sea level, and about 200yds. from the sea shore which runs north-east and south-west, the surrounding country being extremely flat for many miles. This exposure rivals that of sea stations, such as the Bell Rock Lighthouse, described by Mr. Bilham in a recent number of the *Meteorological Magazine*.

The persistence between 23h. on the 17th and 6h. on the 18th of a variation in wind speed having a period of approximately half-an-hour cannot fail to be noticed; while at other times during the day similar rhythmic changes of a less pronounced character can be seen. The changes in wind direction are much less regular. It will be noticed that, even with the wind in the south-west, *i.e.*, blowing parallel to the coast, the gustiness is remarkably low.

According to Baxendell the two principal conditions favouring, but not essential to, the production of periodic changes in air movement, are a west wind and an anticyclonic protuberance.

Neither of these conditions was fulfilled in the present case. An examination of the synoptic charts shows a high pressure area centred over Poland, and a complex depression to the south of Iceland, there being no indication of an anticyclonic protuberance in the neighbourhood of the British Isles. The wind was in a southerly quarter throughout the day.

D. W. JOHNSTON.

Halos

The latest addition to the series of monographs on Cosmical Physics, published by Henri Grand, of Hamburg, is devoted to halos and allied phenomena.* The author, Professor Rudolf Meyer, of Riga, explains in the preface to the book that the subject was to have been dealt with by Erich Barkow, who, as a member of the German Antarctic Expedition, had observed many halo phenomena himself. On Barkow's death Professor Meyer undertook the task of preparing the book. The reader may regret that the personal touch is lost; we do not catch the enthusiasm of the observer who has himself seen strange things in the sky. On the other hand, we have the conscientious work of an author who has studied the literature of the subject very thoroughly and who presents impartially the theories which have been proposed in explanation of the phenomena. The general title halo phenomena is regarded by the author as covering all phenomena due to the reflection or refraction of light by ice crystals. This is, of course, in accordance with precedent. One cannot help wishing, however, that some more suitable term could be found. A sun pillar or a parhelion is not a halo, and either may occur without any halo being visible. It would be an aid to clear thinking if we could refer to these by such a term as chionismic phenomena, χιων being a Greek word meaning snow.

The book before us is in four sections: the first is devoted to descriptions and the results of observations, the second to the general explanation of halo phenomena, the third to the detailed explanation of the various individual phenomena, whilst the fourth gives instructions for observers.

In the first section Meyer emphasizes the need for more observations of a specialised character, as, for example, observations of the polarization of halos and photometric observations of their brilliance. Some standardization of observations is required so that such questions as whether the frequency of halos depends on the sunspot cycle may be settled. The appearance of the ordinary halo of 22° is popularly regarded as a sign of coming bad weather. Solberg is quoted as saying that halos are always associated with warm fronts and have greater value as prognostics than cirrus clouds. We must agree with Meyer that confirmation of these statements by a statistical investigation is highly desirable.

---

* Problems der Kosmischen Physik, Vol. xii, Die Haloerscheinungen, by Prof. Dr. Rudolf Meyer, Riga. Size 9 by 6 in., pp. viii+168, *Illus.*, Hamburg 1929, 11 R.M.

Although the association of halos with ice crystals is generally admitted, there is an extraordinary lack of simultaneous observations of halo phenomena and crystals. Meyer could find only thirteen observations, mostly Dobrowolski's. They are as follows :—

Sun pillars : { Flat crystals (Plättchen) 1, Stars 2.
Flat crystals and Stars 2.
Under-sun (the image of the sun in a cloud below the observer) : Flat crystals 1, Stars 2.
Parhelia : Flat crystals 1.
Paraselenæ : Flat crystals 1.
Ordinary halo with parhelia : Prisms 2, Prisms (some with flat crystals attached) 1.

It is mentioned that the German Antarctic Expedition of 1911-2 secured many micro-photographs of crystals together with simultaneous observations of halos, but these have not yet been published. Now that attention has been called to this omission (which may be attributed perhaps to the death of Barkow), we may hope that the observations will be found and reproduced. Observers in the aeroplanes which ascend to great heights for meteorological observations must have frequent opportunities to collect crystals from clouds in which they have seen halos, but it appears that there are hardly any records of such observations. Professor Meyer thinks that one reason for the absence of information about the forms of crystals is that the symbol ↢ introduced by the International Meteorological Committee in 1873 for "Ice Needles" has been used indiscriminately for crystals of all shapes and sizes.

An interesting chapter is devoted to the question how many ice crystals are needed to produce an appreciable halo effect. It is assumed that in the thinnest halo-forming cloud one-fiftieth of the direct sunshine is deflected. If the crystals are flat plates one square millimetre in area, then 13,000 crystals are required in a sunbeam with cross section one square metre. On the other hand, in a thick cloud nine-tenths of the sunshine is deflected and the corresponding number of crystals is given as 1,450,000. It is estimated that 1,400 crystals, the total weight of which would be a gramme, may be found in a cubic metre, and on this basis the thickness of the cloud is found to be about a kilometre. Here again the author calls for direct observations. Perhaps such observations could be found in the works of Hilding Köhler. There is a significant passage in a paper of Köhler's in the May number of the *Meteorologische Zeitschrift*. Köhler writes that the name ice-cloud is often met with in the literature but that he has never come across any description to justify this name. Halos are formed by ice crystals; but do they develop in the formations which are usually called clouds? All the halos seen near the Haldde Observatory were developed in swarms of crystals which fell from water clouds.

The chapter on the detailed explanations of halo phenomena is notable for the exclusion of mathematics. Those who want to follow the analysis will find ample references to the original authorities. Occasionally one feels that the author might have examined these authorities more closely and given the reader the benefit of his criticism. This is notably the case with Visser's theory of the effect of diffraction in producing the colours of the ordinary halo. Visser claims to explain the rare halos with radii less than 22° by diffraction and Meyer appears to favour this view. The explanation of these halos as due to refraction through pyramidal crystals is mentioned but there is no reference to the work of Besson and of Humphreys on this subject.

In the last chapter will be found descriptions of simple apparatus for the measurement of angles and also some useful hints for photography. It is recommended that special forms should be prepared for noting the development of halos and also that charts drawn on the stereographic zenithal projection should be kept in readiness for sketching the observed phenomena.

The author may be congratulated and thanked for a valuable addition to the literature of Meteorological Optics.

F. J. W. WHIPPLE.

Experiments with Wet-Bulb Thermometers

In connection with Dr. Whipple's articles dealing with this matter, it may be of interest to mention that the arrangements in use for several years and probably at present at Eskdalemuir Observatory are such that water drips from the bulbs of the standard eye-reading and photographic-recording wet-bulb thermometers. The latter are similar to those in use at Kew, but are exposed in a louvred hut in the grounds of the Observatory. I believe that the arrangements referred to were adopted by Dr. L. F. Richardson some fifteen years ago, but I do not know if the dripping of water from the bulbs was planned deliberately.

The water supply is contained in a vessel designed by Dr. Richardson to be proof against damage from frost. The container, which has admirably satisfied the latter condition, is made of copper and in the form of a shallow frustum of a pyramid of square or rectangular section, the sides sloping upwards and outwards from the base. A lid is provided. This container is supported at a convenient distance from the thermometers, and each stranded wick before descending to the bulb rests in a narrow and shallow copper gutter about six inches long fixed to an upper edge of the container. The level of the water in the container is higher above the bottom of the thermometer bulb than is recommended in Dr. Whipple's earlier article. The rate of dripping may possibly be somewhat greater than is necessary.

As to the water which is used: apparently at one time water was drawn from a tap immediately above the container, the water being part of the Observatory supply which is led in from a hill spring about a mile distant. I think, however, that in recent years rain water—of which there is usually no dearth at Eskdalemuir—was used.

H. W. L. ABSALOM.

An Early Episode in the Meteorological Employment of Kites

It may be of interest to call attention to the following extract from the *Philosophical Magazine*, vol. 31, 3rd series, September, 1847, which is liable to be forgotten, though it describes one of the earliest experiments in this country in the use of kites for meteorological purposes.

"*Experiments made at the Kew Observatory on a new Kite-apparatus for Meteorological Observations or other purposes.*

Mr. W. R. Birt (on the 14th of this month) took some kites, etc., to the Kew Observatory, for the purpose of endeavouring to ascertain how far it might be practicable to measure the force of wind at various elevations by their means, and (in the mere manipulations of his experiments) was assisted by Mr. Ronalds. After several trials, etc., they agreed that the sudden variations, horizontal and vertical, in the position of the kite, the great difficulty of making a kite which should present and preserve a tolerable approximation to a plane, that of measuring, with sufficient accuracy, at any required moment, its inclination, and lastly, the influence of the tail, would tend always to render the observations somewhat unsatisfactory. Mr. Ronalds then proposed to try the following method of retaining a kite in a quasi-invariable given position. Three cords were attached to an excellent hexagonal kite of Mr. Birt's construction: one in the usual manner and one on each side (or wing). The kite was then raised as usual; the two lateral cords were hauled downwards by persons standing at the apices of a large equilateral triangle (described upon the ground) until the ascending tendency became considerable (even when the force of the wind was at its minimum), and the three cords were made fast to stakes or held in the hand. He had entertained no expectation of the favourable result of this simple and obvious contrivance. The pace of the kite did not seem to vary so much as one foot in any direction, and it really appears to him probable that a very large kite or kites might be employed in this kind of manner often and very cheaply as a substitute for a captive balloon in meteorological inquiries, or even (on a very extensive scale) for other requirements in military science, etc. An anemometer, a thermometer, an hygrometer, etc., of some registering kinds, etc., might be hauled up and lowered at pleasure (like a flag) by a person standing in the centre of the triangle (above referred to) and by means of a line passing through a little block attached to the kite. The cords and kite should of course be of pure silk, for the sake of lightness, combined with extreme strength, and the size and thickness in some measure adapted to the breeze or lighter air. The silk might be advantageously covered with a very light coat of elastic varnish. (Communicated by Mr. Ronalds)."

Reviews

Einführung in die Geophysik II. Erdmagnetismus und Polarlicht, Wärme-und Temperaturverhältnisse der obersten Bodenschichten. Luftelektrizität. Berlin, 1929.

What strikes one most on reading such a book as this is the advantage that German students have over those in England in the matter of early and easy cultivation of an interest in geophysical subjects. Though specialist interest and intensity of investigational fervour in the physics of the earth are as strong here as in any country, it is in the main true that the general level of knowledge of the subject is unsatisfactorily low. Many honours students can leave the university without being more than dimly aware of the meaning of a regular diurnal variation in the magnetic elements or the potential gradient over the earth or the important influence of the geological structure and vegetational covering on the major relations between the temperature of its surface and its atmosphere; much less the more abstruse aspects of their interpretation. If, discovering his lack, the student has an inward urge to inform himself he must glean what snippets he may from a variety of uncomfortable chapters or appendices in such general text-books as condescend to mention their existence.

Against this, the fortunate German student is presented with such books as the " Einführung in die Geophysik " in close succession to the excellent Handbuchs and Lehrbuchs which have recently appeared. Here from the pens of acknowledged authorities he is offered usefully complete accounts of the existing bodies of knowledge on the subjects of the three sections; terrestial magnetism with its allied topics of earth currents and aurora by Prof. Nippoldt, temperature relationships between the earth's surface layers and the atmosphere by Dr. Keränen and atmospheric electricity by Prof. Schweidler. In those chapters which admit of the help, the facts are presented with a happy admixture of tables, diagrams and pictures: modern hypotheses and lines of further investigation in each department are instructively discussed. The total effect is to produce an eminently readable and even entertaining volume. Perhaps if university graduates in this country were furnished with such volumes, the London Meteorological Office would speedily be inundated with applications to serve at its various observatories.

As only to be expected from the inclusion of three such comprehensive subjects within 375 pages, and as consistent with the object of the volume to be an introduction for non-specialists, there has been a varying amount of sacrifice in the compilation. Except in Dr. Keränen's section the amount of mathematics is negligible and details of instrumental technique are omitted, though the underlying principles are outlined. For those who want more details there are the abundant references in the book as well as the other Handbuchs. The modern problems at present guiding fresh research are clearly kept in view, and very recent results in all the fields covered are discussed. The matter in each section is, naturally, reliable and as comprehensive as the pages will allow; the contributions are written in easy German and printed with accuracy. In a general reading no serious misprints have been noticed. Prof. Nippoldt seems to have been at special pains to add to the gaiety of his section by cutting photographic reproductions from a variety of difficult sources. His chapter on the aurora is specially decorated and thereby has an added interest for readers whose opportunities for viewing the real thing are limited. There are extensive name and subject indexes: the former contains about 400 names with over 1,000 page-references, giving an average of 2½ references per name; Dr. A. Schmidt (Prof. Nippoldt's predecessor at Potsdam Observatory) has 41, Dr. Keränen 30, and Prof. Nippoldt himself 22.

J. M. Stagg.

Nilflutstudien, Beziehungen zwischen den Luftdruck-, Zirkulations-und Temperaturverhältnissen auf der Nordhemisphäre und den Nilfluten. By Fritz Groissmayr. (Ann. Hydrogr., Berlin, LVI, 1928, pp. 6-14), and *Die Nilflut und der Temperaturcharakter des Folgewinters in Leipzig*. By Fritz Groissmayr. (Leipzig, Ber. Sächs. Akad. Wissen, LXXX, 1928, pp. 326-333.)

In the first paper the Nile is correlated with preceding, contemporary and succeeding weather, mainly in the North Atlantic area. The data stop short in 1908 in most cases, but on the other hand go back as far as 1846 in the case of Iceland, or to 1850 in many other instances. It is interesting to note that the existence of a weak North Atlantic circulation following a high Nile is confirmed by these earlier years.

The second paper deals with the relationship of the Nile to the succeeding winter in Europe. A high Nile tends to be followed by a severe winter, and in the case of Leipzig the temperature of December to February has a correlation coefficient with the Nile, July to October, of −0·52, the number of years on which it is based being 57.

E. W. Bliss.

Veröffentlichungen des Forschungs-Institutes der Rhön-Rossitten Gesellschaft e.V Nr. 2 *and* 3. 1929.

The Rhön-Rossitten Company exists to promote gliding flight, which is carried out over the Rhön hills near Frankfort, and over the sand dunes at Rossitten on the Baltic coast. The publication under review was issued by the Research Institute of the Company, under the directorship of Dr. Walter Georgii, and contains a number of interesting articles dealing with aeronautical and meteorological subjects. The observations of the tracks of " no lift " balloons over the dunes and the hills should prove of great value for the detailed study of atmospheric turbulence. One volume (No. 3) is entirely filled with aerological data, extending up to over 5 kilometres in many cases.

Obituary

We regret to learn of the death on January 3rd, 1930, at the age of 75, of Dr. Kiyoo Nakamura, Director of the Central Meteorological Observatory of Japan from 1895 to 1923.

News in Brief

Mr. Richard Inwards, who served on the Council of the Royal Meteorological Society for many years, and as President in 1894 and 1895, attained his 90th birthday on April 22nd and we hope that he will long retain the excellent health which he still enjoys. Mr. Inwards is well known to all meteorologists as a scientific amateur of the best type; his special hobby has been the collection of weather lore, and his book on the subject is the best account in the English language. He has also been a Fellow of the Royal Astronomical Society for many years.

The Weather of April, 1930

Dull unsettled weather with cold northerly or north-easterly winds during most of the later part of the month prevailed generally, except in north-west Scotland and northern Ireland, where the weather was mainly fair and sunny. Owing to a deep depression off our western coasts the opening days of the month were unsettled and stormy with local gales in the west and north on the 1st, 2nd, 3rd and 4th. Rain occurred generally on those days with thunderstorms in northern England and the

Midlands on the 2nd, and snow or sleet showers in east Scotland and east England and the Midlands on the 4th. Among the larger falls may be mentioned 1·45in. at Tynywaun (Glamorgan) and 1·38in. at Dungeon Ghyll (Westmorland) on the 1st. By the 5th the wind had dropped and the weather improved generally. Much sunshine was experienced in the north and west on the 5th and 6th, *e.g.*, 12·7hrs. on the 6th and 12·6hrs. on the 7th at Tiree, and in the south-west on the 7th. The 8th and 9th were cloudy and unsettled with heavy rain in the west, but on the 10th and 11th anticyclonic conditions prevailed and over 10hrs. bright sunshine was recorded at numerous places. By the 12th a depression centred to the north-west was moving eastwards, and in its rear cold north-westerly winds veering north were experienced, with local rain or showers accompanied by thunder and hail on the 14th. These cold winds persisted until the 21st so that the Easter holiday period (18th-21st) was cold throughout the country. It was also dull in many parts of England, but fine and sunny in Scotland and Ireland. Snow and sleet were experienced in Scotland and northern England on the 17th and 19th. A ridge of high pressure was situated over the British Isles on the 21st and 22nd, and sunshine records were excellent in the north on the 21st and in the south on the 22nd, *e.g.*, 13·0hrs. at Rothesay on the 21st and 12·9hrs. at Falmouth on the 23rd. There followed a period of variable weather. On the 25th it was sunny generally, but slight thunderstorms occurred in the Midlands and eastern England and heavy rain in Ireland, *e.g.*, 2·09in. at Delphi Lodge (Mayo). The highest temperatures of the month were reached on this day, when 72°F. was recorded at Greenwich and 71°F. at Norwich. On the 26th an anticyclone over the Atlantic began to spread over the British Isles from the north, giving a general improvement. The last two days of the month were dry, sunny and warm, temperature rising to 70°F. in the south-west and many places enjoying more than 12hrs. bright sunshine; Aspatria had 14·0hrs. on the 30th. Rainfall was generally above normal in England and east Scotland, and below in Ireland and west Scotland. Severe ground frosts were experienced frequently between the 6th and 23rd and on the 30th. The distribution of bright sunshine was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs).
Stornoway	185	+31	Liverpool	104	—54
Aberdeen	100	—58	Ross-on-Wye	110	—40
Dublin	166	+ 1	Falmouth	185	+ 1
Birr Castle	146	— 8	Gorleston	132	—52
Valentia	134	—26	Kew	104	—53

Pressure was below normal over south-western, western and central Europe, the greatest deficit being 6·7mb. at Brest and Bayonne, and above normal over north-western Europe, Spitsbergen, most of the North Atlantic, Bermuda and Newfoundland, the greatest excess being 9·1mb. at Spitsbergen. Temperature was above normal generally, except in Portugal and the west of Ireland, being as much as 8·9°F. in excess at Spitsbergen. Rainfall was also mainly above normal except in northern Scandinavia; the excess amounted to as much as 50 per cent. in south-eastern Gothaland.

Gales were experienced in north-west Spain on the 2nd. Snow fell abundantly in northern and central Italy about the 15th, and heavy rain and storms were reported from many other parts of Italy about the same time, doing much damage to the crops. The Po and other rivers were in flood. Snow also fell in the mountains in Switzerland down to the level of 1,500 ft. about the 20th. Severe frost in France and Switzerland between about the 19th and 23rd did much damage to the orchards and vineyards. After the 24th the weather became warm and sunny generally in Italy.

The floods in Tanganyika had subsided by the 19th. Floods occurred on the river at Voi in Kenya on the 20th, damaging the Mombasa-Nairobi railway there.

A typhoon (unexpected at this time of year) swept across the island of Leyte in the Philippines on the 18th devastating 14 towns and killing and injuring many people. The steamer *Condor* was sunk in the Pabna river, Bengal, with most of the passengers and crew during a cyclone on the 27th.

Ice jams on the Assiniboine River, Manitoba, caused floods in the neighbourhood early in the month. Temperature was above normal generally in the United States during the first three weeks of the month especially in the Missouri Valley, where it was as much as 18°F. above normal at Valentine for the week ending the 15th. The maximum at Chicago on the 10th and 11th was 90°F. After the 22nd there was a big drop in temperature and snowstorms were experienced generally. For the first three weeks the rainfall had been below normal.

The special message from Brazil states that the rainfall was scarce everywhere being 0·91in., 0·55in. and 0·28in. below normal in the northern, central and southern regions respectively. Fewer anticyclones than usual passed across the country. The scarcity of rain has proved harmful to the crops especially the cotton. At Rio de Janeiro pressure was 1·1mb. above normal and temperature 0·7°F. below normal.

Rainfall, April, 1930.—General Distribution

England and Wales	139	per cent of the average 1881-1915.
Scotland	85	
Ireland	75	
British Isles	112	

Rainfall: April, 1930: England and Wales

Co.	STATION	In.	Per-cent of Av.	Co.	STATION	In.	Per-cent. of Av.
Lond .	Camden Square.........	1·86	121	*Leics* .	Belvoir Castle...........	2·64	173
Sur .	Reigate, Alvington.....	1·83	110	*Rut* :	Ridlington...............	3·19	...
Kent .	Tenterden, Ashenden...	1·62	100	*Linc* .	Boston, Skirbeck.......	2·24	166
,, .	Folkestone, Boro. San..	1·93	...	,, .	Cranwell Aerodrome...	3·16	240
,, .	Margate, Cliftonville...	1·28	95	,, .	Skegness, Marine Gdns	2·70	202
,, .	Sevenoaks, Speldhurst	1·70	...	,, .	Louth, Westgate........	2·70	162
Sus .	Patching Farm.........	2·30	132	,, .	Brigg, Wrawby St.....	2·35	...
,, .	Brighton, Old Steyne..	1·73	107	*Notts* .	Worksop, Hodsock.....	2·78	189
,, .	Heathfield, Barklye....	2·12	115	*Derby* .	Derby, L. M. & S. Rly.	2·73	167
Hants .	Ventnor, Roy. Nat. Hos.	2·90	173	,, .	Buxton, Devon Hos....	3·00	102
,, .	Fordingbridge, Oaklnds	2·46	134	*Ches* .	Runcorn, Weston Pt...	2·07	120
,, .	Ovington Rectory.......	...	...	,, .	Nantwich, Dorfold Hall	3·06	...
,, .	Sherborne St. John.....	2·07	117	*Lancs* .	Manchester, Whit. Pk.	1·63	85
Berks .	Wellington College.....	2·04	127	,, .	Stonyhurst College.....	2·17	80
,, .	Newbury, Greenham...	2·52	138	,, .	Southport, Hesketh Pk	2·72	147
Herts .	Welwyn Garden City...	2·57	...	,, .	Lancaster, Strathspey	1·89	...
Bucks .	High Wycombe..........	1·98	126	*Yorks* .	Wath-upon-Dearne.....	2·86	181
Oxf . .	Oxford, Mag. College..	2·06	134	,, .	Bradford, Lister Pk....	3·28	163
Nor .	Pitsford, Sedgebrook...	2·27	148	,, .	Oughtershaw Hall......	4·30	...
,, .	Oundle.....................	2·26	...	,, .	Wetherby, Ribston H.	3·23	183
Beds .	Woburn, Crawley Mill	1·60	107	,, .	Hull, Pearson Park.....	1·90	122
Cam .	Cambridge, Bot. Gdns.	2·08	153	,, .	Holme-on-Spalding.....	2·15	...
Essex .	Chelmsford, CountyLab	2·05	160	,, .	West Witton, Ivy Ho.	4·30	...
,, .	Lexden Hill House....	1·96	...	,, .	Felixkirk, Mt. St. John	4·25	254
Suff .	Hawkedon Rectory.....	2·93	190	,, .	Pickering, Hungate....	3·99	...
,, .	Haughley House........	1·63	...	,, .	Scarborough...............	2·82	181
Norf .	Norwich, Eaton...... ...	2·13	125	,, .	Middlesbrough...........	1·96	143
,, .	Wells, Holkham Hall	...	...	,, .	Baldersdale, Hury Res.	3·04	...
,, .	Little Dunham..........	2·42	149	*Durh* .	Ushaw College..........	2·01	106
Wilts .	Devizes, Highclere......	2·79	147	*Nor* .	Newcastle, Town Moor	1·55	95
,, .	Bishops Cannings.......	3·07	152	,, .	Bellingham. Highgreen	1·81	...
Dor .	Evershot, Melbury Ho.	3·56	151	,, .	Lilburn Tower Gdns....	2·21	...
,, .	Creech Grange..........	2·72	...	*Cumb* .	Geltsdale.................	1·96	...
,, .	Shaftesbury, Abbey Ho.	2·00	94	,, .	Carlisle, Scaleby Hall	1·65	85
Devon .	Plymouth, The Hoe....	3·16	139	,, .	Borrowdale, Seathwaite	4·12	55
,, .	Polapit Tamar...........	2·44	104	,, .	Borrowdale, Rosthwaite	3·01	...
,, .	Ashburton, Druid Ho.	...	...	,, .	Keswick. High Hill.....	1·54	...
,, .	Cullompton.......	3·88	171	*Glam* .	Cardiff, Ely P. Stn.....	2·41	95
,, .	Sidmouth, Sidmount...	3·98	187	,, .	Treherbert. Tynywaun	5·75	...
,, .	Filleigh, Castle Hill....	3·15	...	*Carm* .	Carmarthen Friary.....	2·68	98
,, .	Barnstaple. N. Dev. Ath.	2·89	136	,, .	Llanwrda..................	3·39	103
Corn .	Redruth, Trewirgie.....	3·49	121	*Pemb* .	Haverfordwest, School	3·08	118
,, .	Penzance, Morrab Gdn.	2·36	97	*Card* .	Aberystwyth............	1·58	...
,, .	St. Austell, Trevarna...	3·17	112	,, .	Cardigan, County Sch.	1·62	...
Soms .	Chewton Mendip........	...	...	*Brec* .	Crickhowell, Talymaes	3·60	...
,, .	Long Ashton.............	2·70	...	*Rad* .	Birm W. W. Tyrmynydd	4·39	119
,, .	Street, Millfield	2·85	...	*Mont* .	Lake Vyrnwy...........	4·65	154
Glos. .	Cirencester, Gwynfa....	2·50	134	*Denb* .	Llangynhafal............	4·64	...
Here .	Ross, Birchlea............	3·11	164	*Mer* .	Dolgelly, Bryntirion...	3·12	85
,, .	Ledbury, Underdown..	3·70	203	*Carn* .	Llandudno................	2·68	148
Salop .	Church Stretton.........	3·50	162	,, .	Snowdon, L. Llydaw 9	7·70	...
,, .	Shifnal, Hatton Grange	2·17	129	*Ang* .	Holyhead, Salt Island	2·11	101
Worc .	Ombersley, Holt Lock	2·35	155	,, .	Lligwy.....................	1·85	...
,, .	Blockley..................	3·78	..	*Isle of Man*			
War .	Farnborough.............	2·55	130		Douglas, Boro' Cem....	2·65	109
,, .	Birminghm, Edgbaston	2·70	155	*Guernsey*			
Leics .	Thornton Reservoir....	3·57	210		St. PeterP't. GrangeRd.	3·83	190

Rainfall: April, 1930: Scotland and Ireland

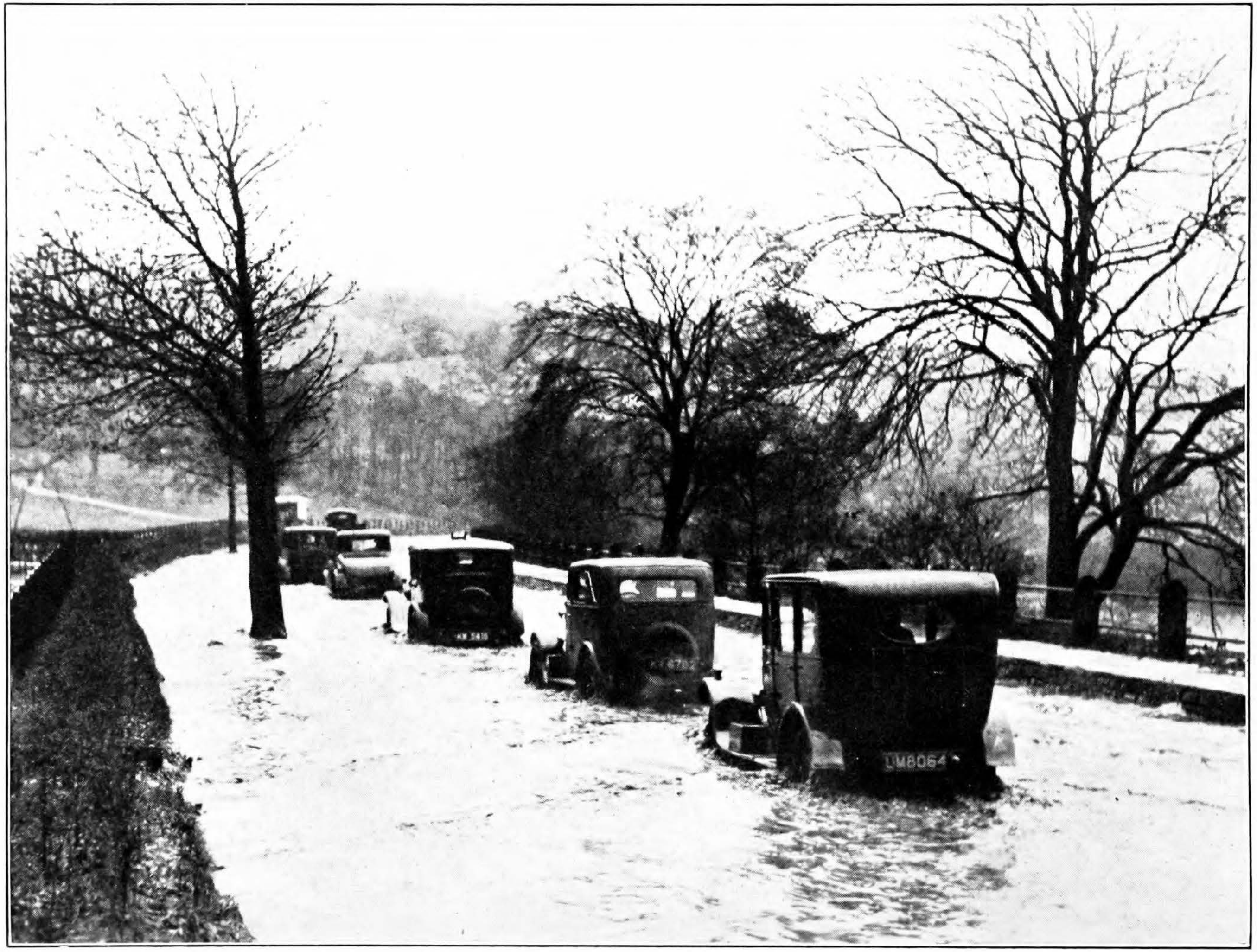
Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Stoneykirk, Ardwell Ho	...	...	*Suth* .	Loch More, Achfary...	2·97	61
,, .	Pt. William, Monreith	1·79	...	*Caith* .	Wick......................	2·12	107
Kirk .	Carsphairn, Shiel.......	3·21	...	*Ork* .	Pomona, Deerness......	2·19	106
,, .	Dumfries, Cargen......	...	...	*Shet* .	Lerwick..................	2·17	95
Dumf .	Eskdalemuir Obs.......	2·35	69	*Cork* .	Caheragh Rectory......	1·89	...
Roxb .	Branxholm..............	1·23	65	,, .	Dunmanway Rectory...	2·36	57
Selk .	Ettrick Manse..........	2·04	...	,, .	Ballinacurra.............	1·78	69
Peeb .	West Linton............	1·60	...	,, .	Glanmire, Lota Lo......	1·88	67
Berk .	Marchmont House......	2·18	108	*Kerry* .	Valentia Obsy..........	3·07	84
Hadd .	North Berwick Res.....	1·25	89	,, .	Gearahameen............	6·90	...
Midl .	Edinburgh, Roy. Obs.	1·17	85	,, .	Killarney Asylum......	...	...
Ayr .	Kilmarnock, Agric. C.	1·69	82	,, .	Darrynane Abbey.......	3·14	91
,, .	Girvan, Pinmore..	2·15	72	*Wat* .	Waterford, Brook Lo...	1·75	69
Renf .	Glasgow, Queen's Pk. .	·92	47	*Tip* .	Nenagh, Cas. Lough...	2·12	84
,, .	Greenock, Prospect H.	2·53	67	,, .	Roscrea, Timoney Park	2·91	...
Bute .	Rothesay, Ardencraig.	3·06	103	,, .	Cashel, Ballinamona...	1·90	76
,, .	Dougarie Lodge.........	2·58	...	*Lim* .	Foynes, Coolnanes......	1·98	81
Arg .	Ardgour House.........	3·49	...	, .	Castleconnel Rec.......	1·71	...
,, .	Manse of Glenorchy...	2·64	...	*Clare* .	Inagh, Mount Callan...	3·09	...
,, .	Oban......................	1·96	...	,, .	Broadford, Hurdlest'n.	1·93	...
,, .	Poltalloch...............	2·46	81	*Wexf* .	Newtownbarry	...	...
,, .	Inveraray Castle...	2·44	53	,, .	Gorey, Courtown Ho...	2·73	125
,, .	Islay, Eallabus...	3·05	106	*Kilk* .	Kilkenny Castle.........	1·59	73
,, .	Mull, Benmore.........	4·50	...	*Wic* .	Rathnew, Clonmannon	1·47	...
,, .	Tiree	2·48	...	*Carl* .	Hacketstown Rectory..	3·01	113
Kinr .	Loch Leven Sluice......	1·61	84	*Leix* .	Blandsfort House......	2·04	78
Perth .	Loch Dhu...............	2·65	56	,, .	Mountmellick...........	1.85	...
,, .	Balquhidder, Stronvar	1·43	...	*Off'ly* .	Birr Castle...............	...	...
,, .	Crieff, Strathearn Hyd.	1·40	64	*Dubl* .	Dublin, FitzWm. Sq...	1·06	56
,, .	Blair Castle Gardens...	1·73	82	,, .	Balbriggan, Ardgillan.	1·12	57
,, .	Dalnaspidal Lodge.....	...	...	*Me'th* .	Beauparc, St. Cloud...	1·40	...
Angus .	Kettins School.	1·75	105	,, .	Kells, Headfort.........	1·52	60
,, .	Dundee, E. Necropolis	2·23	131	*W.M* .	Moate, Coolatore......	1·30	...
,, .	Pearsie House...........	2·89	...	,, .	Mullingar, Belvedere..	1·10	46
,, .	Montrose, Sunnyside...	2·49	137	*Long* .	Castle Forbes Gdns......	1·82	76
Aber .	Braemar, Bank...	2·41	102	*Gal* .	Ballynahinch Castle...	2·98	84
,, .	Logie Coldstone Sch....	2·12	105	,, .	Galway, Grammar Sch.	2·26	...
,, .	Aberdeen, King's Coll.	3·09	165	*Mayo* .	Mallaranny..............	3·03	...
,, .	Fyvie Castle.............	3·34	...	,, .	Westport House.........	1·58	59
Moray .	Gordon Castle...........	1·66	95	,, .	Delphi Lodge...........	5·96	...
,, .	Grantown-on-Spey......	...	...	*Sligo* .	Markree Obsy...........	2·13	80
Nairn .	Nairn, Delnies	1·20	80	*Cav'n* .	Belturbet, Cloverhill...	1·66	72
Inv .	Kingussie, The Birches	1·08	...	*Ferm* .	Enniskillen, Portora...	1·41	...
,, .	Loch Quoich, Loan.....	6·95	...	*Arm* .	Armagh Obsy...........	1·52	72
,, .	Glenquoich..............	4·48	69	*Down* .	Fofanny Reservoir......	2·55	...
,, .	Inverness, Culduthel R.	1·06	...	,, .	Seaforde.................	1·38	53
,, .	Arisaig, Faire-na-Squir	1·89	...	,, .	Donaghadee, C. Stn...	1·31	65
,, .	Fort William...........	1·99	...	,, .	Banbridge, Milltown...	1·49	...
,, .	Skye, Dunvegan........	3·10	...	*Antr* .	Belfast, Cavehill Rd...	1·80	...
R & C .	Alness, Ardross Cas ...	1·81	75	,, .	Glenarm Castle.........	2·42	...
,, .	Ullapool.................	1·65	...	,, .	Ballymena, Harryville	2·21	84
,, .	Torridon, Bendamph...	2·55	49	*Lon* .	Londonderry, Creggan	1·97	77
,, .	Achnashellach..........	3·13	...	*Tyr* .	Donaghmore.............	2·51	...
,, .	Stornoway..............	1·99	66	,, .	Omagh, Edenfel.........	2·06	78
Suth .	Lairg.....................	1·34	...	*Don* .	Malin Head..............	1·86	...
,, .	Tongue..................	·96	37	,, .	Dunfanaghy.............	2·33	...
,, .	Melvich..................	1·20	...	,, .	Killybegs, Rockmount.	2·76	77

Erratum: Inagh, Mount Callan, March, *for* 5·34 *read* 4·80 inches.

Climatological Table for the British Empire, November, 1929.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb							
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1007·4	— 7·2	59	28	50·9	39·2	45·1	+ 1·1	41·7	91	6·8	4·83	+ 2·61	19	2·2	25
Gibraltar	1019·2	+ 1·2	74	46	67·4	51·5	59·5	— 1·0	51·9	81	4·2	2·10	— 4·29	7	..	..
Malta	1015·6	— 0·9	74	49	66·6	57·9	62·3	— 1·6	59·8	88	5·4	4·88	+ 1·31	14	5·8	57
St. Helena	1012·7	+ 1·4	..	54	..	55·2	..	..	56·1	94	9·7	0·70	— 0·98	11	..	..
Sierra Leone	1012·2	+ 1·3	88	68	85·8	73·7	79·7	— 1·5	76·2	82	5·0	6·32	+ 1·20	8	..	..
Lagos, Nigeria	1008·9	— 1·9	91	70	87·0	74·3	80·7	— 0·7	77·2	83	7·6	4·10	+ 1·52	7	..	..
Kaduna, Nigeria	1015·2	+ 3·9	94	..	89·6	..	..	..	70·5	75	1·0	0·00	— 0·12	0	..	..
Zomba, Nyasaland	1006·6	— 2·3	94	59	88·5	68·8	78·7	+ 3·1	..	51	3·2	2·92	— 2·16	8	..	..
Salisbury, Rhodesia	1008·6	— 0·7	95	56	84·1	62·1	73·1	+ 2·4	61·2	45	4·5	4·77	+ 1·07	10	7·7	60
Cape Town	1015·7	— 0·1	89	51	73·2	56·3	64·7	+ 0·3	58·2	69	5·0	0·60	— 0·49	7	..	..
Johannesburg	1011·2	— 0·3	88	44	75·3	55·4	65·3	+ 1·8	57·5	69	4·5	2·93	— 2·03	15	7·6	57
Mauritius	1015·4	— 0·7	90	63	83·5	67·8	75·7	+ 0.2	70·3	59	6·0	0·47	— 1·11	12	9·0	69
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calcutta, Alipore Obsy.	1013·2	— 0·1	87	58	83·6	65·0	74·3	+ 1·2	65·9	83	2·0	0·00	— 0·66	0*	..	..
Bombay	1010·7	— 1·3	95	68	91·8	74·4	83·1	+ 2·6	71·9	74	2·6	0·22	— 0·23	1*	..	..
Madras	1010·7	— 0·6	88	69	84·4	73·0	78·7	— 0·2	74·6	85	6·5	15·07	+ 0·82	12*	..	..
Colombo, Ceylon	1010·1	0·0	89	71	85·1	73·2	79·1	— 0·6	76·4	79	6·5	9·32	— 2·47	22	6·2	53
Hongkong	1018·7	+ 1·1	79	56	72·2	63·7	67·9	— 1·7	60·7	63	5·3	1·37	— 0·30	4	6·3	57
Sandakan	..	..	90	74	87·3	75·1	81·2	+ 0·4	77·2	84	..	19·92	+ 5·26	20	..	..
Sydney, N.S.W.	1009·1	— 4·6	89	51	71·5	58·0	64·7	— 2·4	60·2	64	6·8	3·09	+ 0·28	14	7·2	52
Melbourne	1010·8	— 3·4	88	45	68·0	51·9	59·9	— 1·4	53·7	64	8·1	2·92	+ 0·70	17	4·4	31
Adelaide	1012·8	— 2·3	98	45	75·5	54·2	64·9	— 2·0	54·7	43	6·9	0·96	— 0·20	9	7·9	57
Perth, W. Australia	1013·6	— 1·7	86	52	73·7	57·0	65·3	– 0·7	58·5	59	5·4	1·12	+ 0·33	9	9·4	68
Coolgardie	1011·7	— 1·4	100	47	82·2	55·3	68·7	— 2·1	56·8	45	4·4	1·46	+ 0·78	6	..	..
Brisbane	1010·1	— 4·4	100	54	84·1	64·2	74·1	+ 0·5	65·6	52	3·7	1·25	— 2·41	10	9·3	69
Hobart, Tasmania	1007·8	— 1·6	72	39	61·5	47·0	54·3	— 2·9	50·1	64	7·1	3·14	+ 0·62	22	5·4	37
Wellington, N.Z.	1006·6	— 5·5	66	39	60·3	50·4	55·3	— 1·6	53·4	78	8·2	3·30	— 0·22	12	5.7	40
Suva, Fiji	1008·9	— 2·2	88	70	84.9	73·7	79·3	+ 2·1	75·1	78	6·7	14·23	+ 4·72	18	6·8	53
Apia, Samoa	1007·4	— 2·1	88	72	85·5	75·1	80·3	+ 1·6	77·4	77	4·2	9·43	+ 0·14	14	6·8	54
Kingston, Jamaica	1012·1	— 0·3	89	66	86·4	70·6	78.5	— 0·8	69·6	89	4·9	1·74	— 1·29	10	7·2	64
Grenada, W.I.	1008·8	— 1·5	89	72	87·7	74·6	81·1	+ 1·8	75·3	78	4·1	9·75	+ 1·36	21	..	..
Toronto	1015·9	— 0·9	61	6	43·3	32·4	37·9	+ 1·6	33·1	77	7·5	3·47	+ 0·52	16	2·8	29
Winnipeg	1017·5	+ 0·8	45	—19	24·5	13·0	18·7	— 2.1	..	..	6·2	0·69	— 0.27	9	2·7	30
St. John, N.B.	1015·3	+ 1·4	52	6	42·5	29·9	36·2	— 0·5	32·0	79	6·4	3·60	— 0·81	14	3·9	41
Victoria, B.C.	1026·9	+11·4	55	35	48·7	40·9	44·8	+ 0·4	42·5	87	7·3	1·91	— 4·55	11	3·3	35

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.



A. Anning, Photographer, Ben Rhydding.

Flooding at Escroft, near Ilkley, after thunderstorm lasting half-an-hour, April 25th, 1930 (see p. 110)

M.O. 326.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 65
June 1930
No. 773

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH; YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 15, DONEGALL SQUARE WEST, BELFAST; or through any Bookseller.

The Manual of Meteorology* : Volume II—Comparative Meteorology; Volume III—The Physical Processes of Weather

Sir Arthur Schuster once jestingly proposed that meteorological observations should cease for five years, in order that meteorologists might concentrate their energies on the discussion of the results which had already been accumulated. In the "Manual of Meteorology" Sir Napier Shaw has undertaken, with the sole assistance of Miss Austin, the task which Sir Arthur Schuster suggested as suitable for the meteorologists of the world. The first volume, reviewed in the *Meteorological Magazine* for July, 1927, bore the title "Meteorology in History," and traced the development of the science from the beginning up to recent years; it ends with the comment that most of the contributions to meteorological theory described were very ineffective, because each author "first clipped the universe to fit his theory." Accordingly Volume II, under the sub-title "Comparative Meteorology," is concerned with facts. The facts of the whole universe, so far as they concern meteorology, are presented unclipped, in quotations, in tables, in Sir Napier's own pregnant sentences, and, above all, in a wealth of illustrations.

We say "universe" advisedly, for the first chapter is headed

---

*By Sir Napier Shaw, LL.D., Sc.D., F.R.S., with the assistance of Elaine Austin, M.A., 8vo., 10½ × 7¼, Cambridge University Press; Vol. II, pp. xl. + 445, illus., 1928, 36s. net; Vol. III, pp. xxviii. + 445, illus., 1930, 36s. net.

(89896) P.S. 14/89 1,050 6/30 M. & S. *Gp.303*

"The influence of sun and space," and reflects Sir Napier's often-expressed dictum that the beginning of all weather is radiation, that "it is precisely the part which the atmosphere plays in affecting the incoming and outgoing radiation which is a matter of chief interest for the science of meteorology." Much of the information collected here is not readily available elsewhere in text-book form—but this is a remark which a conscientious reviewer would feel called upon to repeat in connexion with almost every chapter. It certainly applies to the second, dealing with "Land, sea and ice" and other geophysical agencies, four illustrations being devoted to the distribution of sea-ice alone—an index of the importance which is attached to this feature of the earth's surface.

At this stage we are introduced to the series of world charts which make up a notable feature of the volume. These are in pairs, a separate chart for each hemisphere, printed in colour on a background of white and grey, the latter in two shades to distinguish the main oceans from the seas which carry floating ice for part of the year. When it is remarked that there are no fewer than 166 of these charts, it will readily be admitted that not only the authors but the Cambridge University Press also, have been generous to their readers.

The representation of the world in two hemispheres is a logical outcome of Sir Napier's interpretation of meteorology as a dynamic science. He writes: "Furthermore, for adequate conception of the actual behaviour of the atmosphere, the idea of circulation is fundamental, and circulation is related either to the earth's axis, which is permanent, and in that sense meteorologically normal, or to some local axis which is meteorologically speaking transitory. . . . We have, therefore chosen for the ground-plan of the great majority of our maps hemispheres in pairs, Northern and Southern." In these charts the meridians are represented by straight lines, and the tenth parallels of latitude by equidistant circles. This is not a true "projection" in the geographical sense; there is some distortion, especially in low latitudes, which gives the equatorial parts of Africa and America a curiously flattened appearance. Concerning this inequality of scale in different directions, Sir Napier himself remarks that: "An obvious disadvantage of our charts is that the plan of computing the direction and velocity of the geostrophic wind from the separation of consecutive isobars with the aid of a common geostrophic scale is not applicable. . . ." For general purposes they are undoubtedly very convenient, more so, probably, than any of the recognised projections. If one may be permitted a grumble where so much has been given, however, one could wish that the lines of longitude and parallels of latitude had been carried over the continents as well as over the oceans. The location of any specific point in the great land-mass of Asia is a laborious business which involves completing the framework with the aid of a pencil and compasses. The provision in future editions of a complete framework on transparent linen would do much to remedy this defect.

As the ground-work of the charts has been specially drawn for the " Manual," so too have most of the charts themselves. This applies to the monthly charts of temperature, pressure, cloudiness and rainfall, the annual charts of daily range of temperature and the charts of sea temperature for four months, all of which were compiled in the Meteorological Office from the latest data available for each country or ocean. The charts of mean dew-point at sea-level in January and July, which we believe are the work of Miss Austin, are the first attempts ever made towards a world representation of the quantity of water-vapour in the atmosphere. As a whole the charts make up the finest existing climatological atlas of the world.

The charts of mean surface air temperature show the isotherms over the sea quite independently of those over the land. The results are sometimes peculiar, suggesting a sudden jump of 10°F. at the shore line. We suspect that the break is sometimes exaggerated by the observations; in any case the isotherms must actually be continuous, but every sea-side holiday-maker knows that on hot calm days there is a very steep gradient of temperature across the coast, and makes for the " front." Sir Napier's method does bring home this quasi-discontinuity to his readers, in a way which the customary smoothed isotherms fail to do.

Circular maps do not occupy the whole of an octavo page, and the remaining spaces are ingeniously used to present a great variety of information, conversion tables, figures of diurnal and seasonal variation, diagrams and even photographs, related to the subject of the charts.

The charts have been described at some length, partly because many readers will regard them as the most interesting part of the book, and partly because it is possible to give a more or less adequate idea of their contents. Short of making a categorical index of each chapter, the text almost baffles description, ranging as it does from the zodiacal light to earth temperatures, from thunderstorms to correlation coefficients and the structure of barometric depressions. In acordance with the title, everything is treated " comparatively," but where possible it is comparison in three dimensions, and full representation is given to the upper air. Again, there is comparison in time as well as in space, and we have a chapter on " Changes in the general circulation. Resilience or plasticity." To the uninitiate the two ideas embodied in this title seem unrelated; Sir Napier finds the connexion in his idea of the atmospheric circulation as a resilient structure: "It may be disturbed by any temporary exceptional cause such as some peculiarity of the orbits of the sun, moon or planets, a change in the solar energy, or a loss of transparency in the atmosphere on account of dust or carbonic acid gas, an accumulation of ice in the polar regions or a recession of the glaciers of lower latitudes, and so on. When the temporary cause is removed and the conditions are restored to the normal (if that be possible) the circulation will, in virtue of its resilience, recover its normal condition; but it may oscillate about the normal in some period or periods of its own before resuming its normal state." Hence a discussion of periodicities, ending in a list of those ranging from 260 years to one year, which occupies 4½ pages of small print. The volume closes with a somewhat detached appendix containing a list of "forty-five articles expressing the meteorological conditions between the geopotential levels of 400 and 800 geodekametres (approximately 4,000 metres and 8,000 metres in latitude 50°) and their connexions with the layers above and below."

If it is difficult adequately to review Volume II of the "Manual of Meteorology," it is even more difficult to describe Volume III. The sub-title of this volume is "The physical processes of weather"; the introduction records as a suggested alternative *Miscellanea physica.* It is further described as "a reconsideration of the customary meteorological methods of dealing with the atmosphere's reaction to heat," but the first three chapters are concerned with gravity-waves, sound-waves and atmospheric optics. Next of course radiation, its vicissitudes in the atmosphere and the factors which control it. Here we are introduced to the idea of the atmosphere as a heat engine, which dominates the middle half of the book. The most important measure of the state of the air is its entropy, a conception which is not easy to understand, but which governs the stratification of the atmosphere and, in Sir Napier's words, "stiffens the upper layers and protects the empyrean against the ambition of water to make use of its vapour to climb into the Olympian heaven." The word "entropy" slips so easily from his pen that in its various associations it requires 69 references in the index, many of which are illustrated by diagrams. As there are in addition 33 references to the tephigram, representing the relation of entropy to temperature, an understanding of this difficult conception is a necessary preliminary to the study of the physical processes of weather. "Open, entropy!" is the key-word to Sir Napier's cave of treasures.

Even so, one doubts if many meteorologists who start this book at the beginning will succeed in reading solidly through to the end of Chapter VIII. The very multiplicity of topics destroys sustained attention, while the freshness of treatment, by presenting familiar matters in a new light and asking questions which as yet not even the author is competent to answer, makes the mind wander, until one lays down the book to follow a train of thought. So, at least, has the reviewer found it, and so, he thinks, would the author prefer it.

The last two chapters are on a different footing. That on "electrical energy in the atmosphere" is almost equivalent to a history of the study of atmospheric electricity from Maxwell to G. C. Simpson, but the end, we gather, is not yet. The final chapter, "Convexion in the general circulation," though short, is in some ways the most interesting of the whole book. The idea of motion along isentropic surfaces, guided by the distribution of pressure and the earth's rotation, is brought into connexion with the distribution of cloud and rainfall to form three natural regions, advective or "gathering," divective or "strawing," and intermediate. The typical advective region is the "gathering storm," but no obvious relationship is found between the mean monthly isobars or isotherms and the boundaries of these natural regions, and we are left with the demand for synoptic charts of isobars along isentropic surfaces as the ultimate expression of the circulation of the atmosphere.

The science of meteorology has grown up in somewhat haphazard fashion; it is an unruly boy whom Sir Napier has undertaken to school. The process is at times painful. Old lax habits must be given up, old vague terms must be closely defined, a new vocabulary must be learnt. It is not the least part of our debt that Volume II opens with a list of "definitions and explanations of certain technical terms," and Volume III with a "list of words used in special senses or not yet incorporated in the *New English Dictionary* that have been found convenient for the avoidance of misunderstanding or for the sake of brevity." There is also a gallant attempt at the introduction of system into the use of symbols; the suggested list covers five pages and involves upper and lower case, roman and italic, Greek uncial and minuscule, and even so cannot avoid, for example, four meanings of *v*—velocity, specific volume, vapour pressure and voltage. Still, we are spared incursions into Coptic, and the meaning of the symbols in the text is always clear.

In the matter of units, one cannot help wishing at times that logic was not pushed so far. Millibars are old friends now (incidentally it is rather a shock to come across millibars not corrected to standard gravity), and many English meteorologists are almost as familiar as their Continental confrères with rainfall in millimetres. On the other hand, those brought up on gram-calories per square centimetre find it hard to think of radiation in kilowatt-hours, for it is easier to imagine the sun as warming a kettle of water than as lighting an electric lamp. In the world charts of temperature Sir Napier has been kind, and has given us Fahrenheit degrees (with the curious exception of the mean seasonal range of temperature, which is in centigrade degrees), but throughout Volume III we find every figure of temperature followed by the mysterious symbol " tt." He himself made us learn the absolute scale; the tercentesimal, we are told, differs on technical grounds and so requires a different symbol. The practical difference is so small that one regards the two symbols as interchangeable, and makes a mental correction: " for tt read °A."

These are details, however, and matters of opinion at that; beside the solidity of the three volumes of the " Manual " already published they sink into insignificance. At long last Sir Napier Shaw and Miss Austin, with the co-operation of the Cambridge University Press, have removed the reproach that there existed no work in English comparable in scope with Hann's great *Lehrbuch*. More, for while the *Lehrbuch* pretended to be no more than a compilation and summary of pre-existing knowledge, the " Manual " contains new knowledge and new ideas in abundance. In a sense the work is now complete, for the contemplated fourth volume was issued as early as 1919 under the title " Part IV. The relation of the wind to the distribution of barometric pressure." In the interval, however, there have been several interesting developments of dynamic meteorology, and we look forward to Sir Napier's exposition of these, confident that though he may startle us at times he will at least illumine our darkness.

Thunderstorm near Ilkley on April 25th, 1930.

Some details of the thunderstorm at Ben Rhydding, to the east of Ilkley, on April 25th, 1930, have been very kindly supplied by Mr. Terence More, The Cottage, Ben Rhydding.

At The Cottage, 50 yards from Ben Rhydding railway station, thunder was first heard at 15h. 25m.,* and rain began at 15h. 30m., changing to hail at about 15h. 40m. The hail lasted for 5 minutes or a little longer, and rain continued until just before 16h. It is estimated that 1·84in. of rain fell at Ben Rhydding in 30 minutes, but the gauge was not emptied until May 1st, 2·22in. having been collected in seven days. At Ilkley (Spence's Garden) about 2 miles further west, 1·08in. was recorded as falling from 16h. to 16h. 25m. The thunder and lightning were violent. One flash was said to resemble a ball of fire as it passed over The Cottage in a west-east direction, to shatter the chimney of a house 150 yards away. A house 100 yards north of The Cottage was also struck. Some of the hail stones were described as being half an inch in diameter. Street lamps at an elevation of 800ft. south of Ben Rhydding, had their glass panes broken presumably by the hail. The wind, which was east in the morning, must have changed during or before the fall of hail, for the stones reached 6 inches up the well in the east-north-east corner of the yard. After the water had subsided from this yard, 7ft. square, it was estimated that a wheelbarrow could still be filled with the hail that was left there.

---

*Greenwich Mean Time is used throughout this article. Add one hour to get summer time.

The general meteorological situation on the morning of April 25th was not unusual, shallow depressions extending from the south of Scotland to the Bay of Biscay. The inference was "weather will remain rather unsettled with some local rain or showers, some bright periods and also a tendency for thunder." The approach of the storm was heralded by a dark cloud first sighted over Alms Cliff Crag and to the east-north-east. It came towards Ben Rhydding skirting Pool and Otley. At Burley it broadened and may have been joined by another storm from the southeast or south. From Burley the storm travelled along both sides of the valley, the rain being somewhat less intense over the middle of the valley than up on the hillsides. The rain appears to have become heavier near Ben Rhydding on the south side and March Gill Reservoir on the north. West of Ilkley the amount of damage was less. The sky cleared first in the east at the end of the storm. The Surveyor and Water Engineer at Ilkley confirms this. "The rainstorm was most concentrated at Ben Rhydding, there being comparatively little rainfall at Hebers Ghyll (to the west of Ilkley) whilst near Burley Wood Head (to the southeast of Ben Rhydding) the rain was exceptionally heavy." There is some evidence of heavy rain to the north of Ben Rhydding on the hills near Middleton on the other side of Wharfedale.

The photograph (taken by Mr. A. Anning, Valley Drive, Ben Rhydding) shows the main road from Ilkley to Otley, at Escroft, about 1½ miles below Ben Rhydding. The photograph is taken looking towards Rumbald's Moor. There is hail on the wooded hillside in the background, but none on the footpath. The River Wharfe, visible through the railings on the right, is no higher than the ordinary winter level.

The caretaker at The Cottage was working in a garden near the moor above Burley on the occasion of the Ilkley flood of July 12th, 1900. In comparing the two storms he says they were similar in respect of the violence of thunder, lightning and hail. The storm was of shorter duration on April 25th, 1930, but was more severe while it lasted than the storm above Burley in 1900. The latter was, of course, much more severe at Ilkley. Also, it moved from south to north, at right angles to Wharfedale, whereas it is probable that the present storm travelled from east to west.

The heavy rain of April 25th, 1930, is striking because of its occurrence early in the year. Mossman found* that only 1·2 per cent. of the heavy rains in short periods during the 46 years, 1868 to 1913 occurred in April, the frequency being greatest in June, July and August.

This heavy rain is also of unusual interest since it fell in the neighbourhood of Ilkley. In the paper on "Intense and Widespread Falls of Rain"† attention was directed to the peculiar grouping over the British Isles of the intense falls on record, and reference was made to three near Ilkley. These occurred at Huddersfield on July 24th, 1904, on Embsay Moor (draining to the Wharfe above Ilkley) on June 3rd, 1908, and at Ilkley on July 12th, 1900. There was in addition a severe storm at Ilkley on June 18th, 1872, although a precise comparison is not available. "The destruction of flood gates, culverts and small bridges on the streams flowing down the sides of these ranges into the Ribble and Wharfe Valley was enormous on this day."‡ The Ilkley flood of July 12th, 1900, one of the most outstanding rain-storms experienced anywhere in the British Isles, was discussed by Dr. H. R. Mill in *British Rainfall,* 1900, pp. 16-22.

J. GLASSPOOLE.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, May 21st, in the Society's rooms, 49, Cromwell Road, South Kensington, Mr. R. G. K. Lempfert, C.B.E., M.A., President, in the Chair.

Sir Napier Shaw, Sc.D., F.R.S., gave an account of Dr. Moltchanoff's method of automatic signalling of the results of sounding of the upper air.

Sir Gilbert T. Walker, C.S.I., F.R.S.—Seasonal foreshadowing.

This paper contains some applications to seasonal foreshadowing of the tables of relationships given in previous studies of world weather. Methods applicable to the monsoon rainfall of north west India and the Peninsula, to the height of the Nile and the river Parana in Brazil, and to the rainfall of Ceará in Brazil had already been published; and as the swayings of the southern oscillation affect the winter temperatures of south west and north west Canada as well as the summer rainfall of South Africa and Australia it was natural to see how far conclusions of practical value could be derived. The rainfall data have not been based on as many stations as is theoretically desirable, but the resulting total correlation coefficients in the

---

*See *British Rainfall,* 1913, p. 49.

†*London, Proc Inst. Civ, Engin.,* 1929.

‡See *British Rainfall,* 1872, p. 61.

four cases are ·71, ·72, ·72 and ·79, values which would seem to justify a prediction in general terms in nearly half the years of a long series.

A. C. Best, B.Sc.—Instruments for obtaining dry and wet bulb temperatures.

The efficiency of the Casella-type Assmann psychrometer is discussed, and attention is drawn to the defects of this type. Of these the chief defect is the low rate of aspiration. Experiments are described showing that the rate of aspiration in the above type psychrometer starts at about 1·5 metres per second. A modified form of the Casella-type psychrometer is then described in which the aspiration, effected by a small electric motor, has the value of 5 metres per second. It is shown that this psychrometer will run for about eight minutes in air having a relative humidity of 33 per cent before the wet bulb dries up.. The results of comparing the depressions given by these two psychrometers, two types of sling psychrometers and a Stevenson Screen are given. Two methods of measuring the rate of aspiration were employed. In the first a hot wire anemometer was used. This instrument is described. The second method was by timing a puff of smoke up a glass tube.

Correspondence

To the Editor, *The Meteorological Magazine.*

Experiments with Wet-Bulb Thermometers

In connexion with Dr. Whipple's note in the April number regarding experiments with wet-bulb thermometers, it may be of interest to mention another simple method of avoiding the errors associated with salt deposit. This method was tested at Malta during the past year with satisfactory results, and a report made in February on it is under consideration by the Director of the Meteorological Office.

The method consists simply in raising the water container on a block, so that the muslin and wick are completely immersed inside the container in the interval between observations. A thin desk of cork or cardboard is fixed on the thermometer stem, and roughly closes the mouth of the container when it is raised in the block. The container is lowered to its working position ten minutes before the observation is made.

With this arrangement it is only necessary to renew occasionally the water in the container: the same muslin and wick will last for a long time. Also it is perfectly easy for any observer to adopt it either on board ship or on land.

Meteorological Office, Malta. W. A. HARWOOD.

Dr. Whipple's article on "Experiments with Wet-Bulb Thermometers " in the April number reminds me of a series of similar experiments which were made at Valentia Observatory 14 years ago. As the results were not published at the time a brief summary of the conclusions reached may be of interest.

First a spare wet bulb adjacent to the standard one was supplied with sea water in the bottle instead of fresh. As might have been expected the bulb so treated read on the average consistently higher than the standard. Secondly, the same bulb supplied with fresh water in the normal manner was on a definite occasion deliberately contaminated by dipping the bulb into sea water. The immediate result was very much the same as when the whole water supply was salt, but the important point is that the effect was permanent, and it was evident that with the usual arrangement of water bottle and wick the salt solution remained on the bulb and did not diffuse back along the wick.

Finally an arrangement similar to that described by Dr. Whipple was used, giving a continuous slow circulation of water over the bulb. At intervals of a few days the bulb was contaminated by means of sea water as before, but whatever the effect may have been immediately afterwards it practically all disappeared in an hour or two.

The conclusions reached were entirely consonant with those which Dr. Whipple has obtained at Kew, and both of them suggest the query. . . . What is the magnitude of the systematic error which is produced in the use of the standard wet bulb on board a ship at sea? That there must be a systematic error is certain, because with breaking waves minute particles of salt water are carried by the air, even though there be no obvious spray. Such particles are caught on the wet bulb and once caught produce a permanent effect till the muslin is next cleaned or changed.

It would be instructive to run two wet bulbs in the same screen on a ship, one of which was supplied with water on Dr. Whipple's plan, and to compare the results over a year's working. A great point in favour of the method of continuous flow is that it entails no trouble beyond a regular replenishment of the water supply, and actually reduces the frequency with which the muslin need be changed.

L. H. G. Dines.

Kew Observatory, Richmond, Surrey. May 23rd, 1930.

Display of Mock Suns

At 6 p.m. on May 1st, while in the southwest district of London, I noticed a display of " mock suns " similar to that witnessed by me at Guildford in October, 1927. On the present occasion the display was not quite so well defined as previously, but the two " suns " were distinctly visible one on either side of the actual sun, horizontally, and intersected by the halo. The weather conditions at the time were fine with a moderate but very cool northeast wind, the sky being almost clear of cloud, except, of course, in the neighbourhood of the sun where appeared the usual cirrus and cirro-nimbus clouds, thickening towards the western horizon. The halo was clearly marked in the lower and more cloudy part of the sky and the portion immediately above the sun could be seen, though less distinctly, even against the blue sky.

On my arrival at Guildford later in the evening, I had another view of the display. The sun had fallen lower in the heavens to a point within about 15° of the horizon and was more enveloped in cloud. The two " mock suns " and also a part of the halo had disappeared, but another " sun " though less bright now, appeared in the remaining part at its apex. This, however, did not last very long, and within a quarter of an hour the whole phenomenon had faded away.

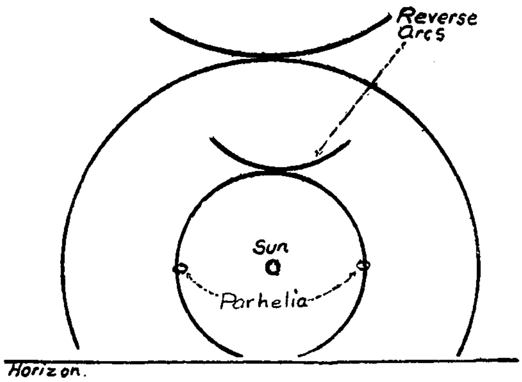
Probably other readers witnessed the display, some perhaps to better advantage.

H. J. WELLER.

Hogs Back, Guildford. May 5th, 1930,

While gardening on the morning of Saturday, May 17th, I observed the following. (British summer time is used throughout.)

Sunrise was clear. At 6h. 15m. cirro-stratus which had arrived from the southwest produced the halo of 22° with parhelia each side of the sun. At 6h. 30m. the parhelion south of the sun was hidden for a few minutes by a patch of alto-cumulus. At 6h. 40m. the halo of 46°, with reverse arcs on zenith of both halos as shown in sketch, appeared very distinctly. Coloration was very bright. All the phenomena remained visible until blotted out by increasing and thickening cirro- and alto-cumuli at 7h. 5m. Visibility was good.



At 7h. I noticed an isolated patch of alto-cumulus approaching from the northwest transversely to the main cloud mass.

F. CLAUDE BANKS.

Horndon-on-the-Hill, Essex. May 19th, 1930.

Delayed Ink Feed For Crowquill Pens

A method has been devised whereby pens of the crowquill type as fitted to pressure-tube anemographs can be loaded to their full capacity, without fear of the recording ink dropping off. The pens, furthermore, have been found to function satisfactorily without any special treatment such as tempering, etc.

The method then, is to insert a piece of wick (as supplied for use with the wet-bulb thermometer) through the entire length of the pen and its elbow joint. This single strand of wick should reach to within two millimetres of the point of pen, and may extend about the same length outside the elbow joint. A few drops of ink can then be placed on this protruding wick, which will readily conduct to the point of pen. It may assist in cases to apply a slight pressure on the pen points in order to open them out a trifle and give the point an initial supply of ink. This may be done with the aid of a penknife. Further ink may now be added; the presence of the wick enables a larger quantity to be held without fear of running off.

A new pen fitted with one strand of wick records very satisfactorily for 48 hours without any attention or the addition of fresh ink.

Trials were made with two and three pieces of wick, and also with wick applied to the "Starr" double pen. In the former cases the ink feed did not last so long, owing to the restricted space for ink, and in the latter case the ink was fed too freely.

Experiments have been made over a reasonable period, incorporating light and strong winds, and every excursion of the pen has been recorded.

P. R. Zealley.

School of Artillery, Larkhill, Salisbury Plain. May 15th, 1930

NOTES AND QUERIES

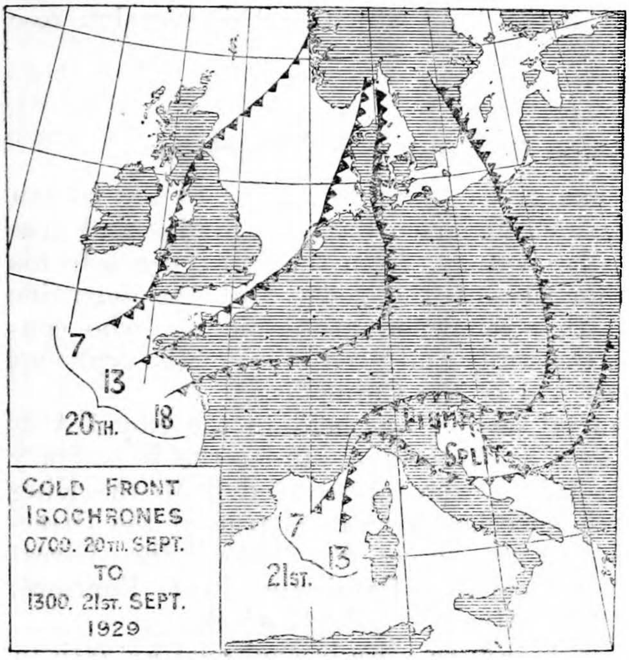
Line-Squall and Bora at Split, Dalmatia, on September 21st, 1929

Attention was drawn to this line-squall and bora by Lt. Moorhead, R.N., of H.M.S. *Eagle*, moored off Split at the time.

The line-squall passed over Split at 12h. 5m. G.M.T. The wind veered very rapidly from SW to NW and rose to force 7-8 during the squall. A line cloud accompanied the squall with heavy rain and some thunder. The *Eagle* thermogram shows an almost instantaneous fall of temperature from 78° to 64° and a further fall to 60° soon after. Later in the day the temperature rose to 66°. The barogram shows a well-marked trough. After the squall the wind fell off to force 4 and then veering rapidly to NE (bora) blew for several hours at force 7-8.

The weather record of H.M.S. *Queen Elizabeth* at Fiume, some 160 miles to the north of Split, shows that the squall passed over there at 9h. This squall was given by a well-marked cold front whose movement between 7h., 20th, and 13h. 21st, is shown in the diagram. The front travelled from the English Channel and eastern North Sea to the central Adriatic in 24 hours. It was associated with a deep depression over Scandinavia.

The forecasting of bora winds in the Adriatic appears to be largely a matter of following cold fronts moving south or south-east over central Europe. Some fronts are held up considerably by the Alps and it is difficult to estimate how much a given front is going to be held up in this way. A cold front which followed the one above described was, in fact, held up for about 24 hours by the Alps. This front was to be seen moving southeastwards over the British Isles at 7h. on the 21st and reached Austria and the Alps on the following morning, the 22nd. As mentioned above, it was held up on the mountains and the cold air did not come down into the Adriatic until 7h. on the 23rd when Trieste reported wind NE, force 5. The cold air did not reach Split until 23h. 30m. No very definite squall occurred at that time but wind freshened considerably from NE and blew until the 27th, reaching force 7-8. Temperature showed no sudden change but maxima on the 24th and succeeding days were below 70° compared with one of 80° on the 23rd. Both fronts were associated with the same depression over Scandinavia but this had filled considerably in the interval between them and the gradient for the onward movement of the second was smaller. A large anticyclone built up over central Europe behind the second front and gave steady NE winds in the Adriatic.



G. A. BULL.

" Willy-Nilly " in Crete

We owe to Pilot S. J. Stocks, of Imperial Airways, through the agency of Captain J. Durward, a description and photograph of a curious phenomenon which he observed at Mirabella in Crete on January 15th, 1930, and which is termed a " willy-nilly." The photograph, which is not reproduced, shows a lagoon backed by mountains from 2,000 to 4,100 feet high; the usually calm water of the lagoon is much disturbed and the base of the mountains is blurred by a dense mist of spray, which rises to a height of 600 feet on the seaward or foremost edge of the disturbance and has an average height of 400 feet.

The "willy-nilly" did not revolve like a water-spout, but consisted of an irregular belt of violently rising air, about 600 yards long and 200 yards wide. The vertical motion is strong enough to raise the surface of water as spray and sometimes to carry up small pieces of seaweed and light wreckage. It travels with the speed of the wind which on this occasion rose to 60 m.p.h. in gusts.

Commemoration Ceremony at Barcelona

The City of Barcelona has given great solemnity to the return of the remains of the Rev. F. Federico Faura, founder and first Director of the Manila Observatory, from the Philippines to his native land. The authorities of the town and the scientific societies have honoured this renowned meteorologist, who consecrated his whole life to the study and prediction of the typhoons of the Philippine Islands and of the China Sea.

On May 23rd a memorial session was held in the Royal Academy of Sciences and Arts at Barcelona, under the presidency of H.H. the Prince Don Jaime, who represented H.M. the King of Spain. The panegyric speeches were in charge of the Director of the Ebro Observatory, Rev. F. Rodés, the Director of the Meteorological Service of Catalonia, Prof. Fontseré, and the Vice-rector of the University, Prof. Alcobé.

The remains of the Rev. F. Faura were buried on May 24th in the new Church of Artés, a little Catalonian village, where he was born in 1840.

E. Fontseré.

Reviews

Grundzüge des Klimas von Muottas-Muraigl (Oberengadin). Eine meteorologisch-physikalisch-physiologische Studie. By Prof. Dr C. Dorno. Size 8¾ × 5¾in., pp. xi + 177. *Illus.* Brunswick, 1927.

The actual observations at Muottas Muraigl (in the Upper Engadine, height 2,456m.) upon which this book is based were taken on about 40 days between July, 1923 and June, 1924, the five periods ranging in length from two days in June, 1924, to thirteen in October, 1923. It was doubtless this paucity of data which led to the author's choice of title for a book which otherwise suggests thoroughness. During the periods selected at different seasons of the year the observations taken included meteorology, radiation of various kinds, meteorological optics, atmospheric electricity and physiology. Comparisons were made with observations at Davos, 900m. lower than Muottas and several conclusions are drawn as to the rate of change of conditions likely to exist between 1,500m. and 2,500m. compared with that between 500m. and 1,500m. Large increases are indicated not only in ultraviolet radiation from the sun and the cooling properties of the air but also in electric potential and conductivity.

That the section on meteorology should be comparatively short, occupying only about one-fourth or less of the space devoted to radiation and physiology severally, is in accordance with expectations from the pen of Prof. Dorno. The treatment of the latter subjects includes criticism of several instruments and methods of observation. L. D. SAWYER.

The Glacial Conditions and Quaternary History of North-east Land. By K. S. Sandford. London Geogr. J., 74, 1929, pp. 451-70 and 543-52.

North-east Land, the furthest removed of the Spitsbergen group of islands, is about the size of Wales, but presents in miniature nearly all the features of a continental ice-sheet. There are three " domes " of ice, which give rise to their own characteristic blizzards, a zone of " highland ice " in which the contours of the ice surface are determined by the conformation of the ground beneath, and a number of interesting coastal features—small glaciers, ice cliffs and dead ice.

At present the loss by ablation, melting and calving of icebergs is very nearly if not quite balanced by the supply of new snow, so that the ice is either stationary or retreating almost imperceptibly. The moraines and raised beaches show evidence of more violent fluctuations in the past; at one stage, many thousands of years ago, the glaciation was more extensive than it is at present, though there is no means of knowing whether this coincided with the last maximum of glaciation in Europe. During this glacial maximum the island lay more than 200 feet lower than at present; the raised beaches formed during this period sink towards the heads of the fiords, suggesting that the subsequent elevation was due to isostatic compensation after the withdrawal of the thick ice from the coasts. The period of elevation was associated with warmer seas than the present, the deposits including *Mytilus edulis*, a temperate species which cannot live in arctic waters where shore-ice is formed, although the ice-foot now persists throughout the summer.

Over the lower raised beaches there is in some places recent boulder clay, pointing to a sub-recent re-advance of the ice beyond its present limit, and there is some evidence that in the last few decades the ice has retreated locally for a small distance.

Books Received

Jaarboek, Koninklijk Nederlandsch Meteorologisch Instituut, 1927, A. Meteorologie, B. Aard-Magnetisme (No. 97). Utrecht, 1928.

Ergebnisse Aerologischer Beobachtungen, 1927. K. Ned. Meteor. Inst. (No. 106A). Utrecht, 1928.

Onweders, Optische Verschijnselen, enz. in Nederland. Naar Vrijwillige Waarnemingen in 1926. Deel xlvi. K. Ned. Meteor. Inst. (No. 81). Amsterdam, 1928.

Nautisk-Meteorologisk Aarbog, 1928. The Danish Meteorological Institute, Copenhagen, 1929.

Obituary

Dr. Fridtjof Nansen.—With the death of Dr. Nansen on May 13th the world lost a great humanitarian and science lost an intrepid pioneer and explorer. His work on the repatriation of German and Russian prisoners of war, on famine relief in Russia, on the resettlement of Anatolian refugees and in the service of the League of Nations, has been adequately described in *The Times* and elsewhere, but by meteorologists and geographers he will be remembered as the man who first opened to science the frozen centre of the Arctic Ocean.

Nansen was born at Christiania (now Oslo) on October 10th, 1861, and after taking the degree of Doctor of Philosophy at the University of Oslo, he made his first acquaintance with the Arctic in 1882 during a voyage to the east coast of Greenland in the sealer *Viking.* His daring as an explorer was made known to the world by his successful leadership of an expedition across the Greenland ice-sheet in 1888, the first time that great area of inland ice was crossed from coast to coast. The results formed one of the earliest contributions to the problems of the nourishment of an ice-sheet and the " glacial anticyclone."

Nansen's knowledge of oceanography led him to infer the existence of an ocean current crossing the North Polar Basin from east to west, and in 1893 he set out in a ship, the *Fram,* designed especially for the purpose of being frozen-in north of Siberia and drifting in the ice across the neighbourhood of the pole. This daring programme was successfully carried out, the ship became fast in the ice in September, 1893, in 78° 43′ N., and did not emerge until August, 1896, near Spitsbergen, after reaching a latitude of 85° 56′ N. in longitude 66°E. Full bi-hourly meteorological observations were maintained throughout this period of nearly three years, in a region the meteorology of which had previously been entirely unknown; in addition Nansen with one companion left the ship in March, 1895, on a sledge expedition over the ice, and obtained a second series of observations still further north between that date and June, 1896. The meteorological results of the expedition were set out by Prof. Mohn in a volume of 659 pages which has formed the starting point for all subsequent discussions of polar meteorology, and has added more than any other single work to our knowledge of the atmospheric circulation in high latitudes.

After an interval of political and diplomatic service in 1906 Nansen became Professor of Oceanography at the Unversity of Oslo, and took part in several expeditions to investigate the oceanography and marine meteorology of the North Atlantic. The results were published in a number of separate papers and one compilation, written in association with B. Helland-Hansen, well known to meteorologists under the title "Temperature variations in the North Atlantic Ocean and in the Atmosphere." This great work, which was issued by the Smithsonian Institution in 1920, includes a discussion of all the literature on the relation of sunspots to weather published up to 1917. His interest in Arctic problems remained fresh, however, and in the last years of his life he assisted in founding a society known as the "Aeroarctic" for the exploration of the north polar regions from the air. Nansen had arranged to visit this country to explain the programme of "Aeroarctic" in a lecture to a joint meeting of the Royal Aeronautical and Royal Meteorological Societies on March 14th, 1930, and it was a great disappointment to all British meteorologists when his illness made it necessary to cancel the visit. Their sorrow would have been still greater had they known that the opportunity was never to return.

News in Brief

At a meeting of the Senate on March 26th, 1930, it was decided to confer on Sir Gilbert Walker, C.S.I., Sc.D., F.R.S., the title of "Professor of Meteorology in the University of London," with the status and designation of "Appointed Teacher."

All who are interested in meteorology will congratulate Sir Gilbert Walker on the added dignity, which may be taken as marking a definite advance in the status of the science of meteorology in this country.

The honour of a Knighthood has been conferred on Mr. Henry William Watson McAnnally, C.B., J.P., Principal Assistant Secretary in the Air Ministry.

On June 30th Mr. R. A. Watson retires from the directorship of the Royal Alfred Observatory, Mauritius, which he has held for three years. His place will be taken by Mr. McCurdy, while Mr. M. Herchenroder becomes Assistant Director.

Mr. J. Wadsworth has resigned his post in the Meteorological Office in order to take up a new appointment as Director of the Apia Observatory, Samoa, in succession to Mr. Andrew Thomson.

The Weather of May, 1930

The weather of May was characterised by lack of sunshine, except in the extreme north-west; and although in south-east England the month was wet, Kew Observatory experiencing the wettest May since 1886, most districts had less than the average rainfall. The sunny weather of the closing days of April continued on the 1st, many stations recording over 11 hrs. bright sunshine, and Aberdeen 13·8 hrs. There was a general increase of cloud in the next few days, and thunderstorms occurred locally in England on the 3rd, 4th and 5th. Fog occurred in several parts of England in the early morning of the 5th. A depresion from the west of Ireland then spread to the southern part of the country and rain fell over most of England in the early hours of the 6th, while by the 7th northerly winds had spread to all parts of the country and hail showers fell in east Scotland and as far south as Harrogate. Cold showery weather continued for a few days, minimum temperatures of 28° occurring at Kilmarnock and Aspatria on the 8th, 29° at Fort Augustus on the 9th, and 28° at Durham on the 10th. On the 11th a small depression crossed the British Isles, causing rain or showers in most districts and a gale in the English Channel. Variable but mainly unsettled weather with southwesterly winds then set in and conditions became somewhat milder. On the 17th heavy rain fell locally in northern England, Scotland and Ireland, Borrowdale (Cumberland) having 1·70 in., Eskdalemuir 1·18 in., Roches Point 0·87 in., and Fofanny (Co. Down) 1·41 in. On the 18th a deep depression centred north of Scotland moved slowly westward, and strong westerly winds were general, while gales occurred in parts of Scotland. In the midlands and south of England, however, considerable sunshine was experienced and Guernsey had 13·6 hours. Following this depression anticyclonic conditions developed; the weather was mainly cloudy, however, until the 20th; varying amounts of sunshine were recorded, but day temeratures mostly failed to reach 60°. Rain fell locally during this period but amounts were generally not large. Thunderstorms occurred locally in the south-east on the 19th.

Considerable sunshine was experienced in the north on the 21st and 22nd, Douglas having 13·4 hrs. on the 21st and Lerwick 15·3 hrs. on the 22nd; but on the 22nd the midlands and south-east of England were influenced by winds associated with a low pressure area on the Continent, day temperature at Kew Observatory failing to exceed 51°. An improvement occurred on the 23rd, many places having over 13 hrs. of bright sunshine. Rather cloudy weather with local thundery showers prevailed for the next few days. On the 26th falls exceeding one inch were measured at a few places in England, Derby having 1·35 in. Fog persisted off the east coast during most of the 25th and impeded air and sea transport in the English Channel. On the 26th temperature reached 71° at Renfrew, and on the 27th day temperatures generally rose above normal. 74° was recorded at Greenwich on the 29th. On the 28th and 29th good sunshine records were obtained at many places, 14·5 hrs. at Lympne on the 28th, and 14·4 hrs. at Lerwick on the 29th. On the 30th a depression developed in the Bay of Biscay and over western France, and later in the day widespread rain and drizzle occurred over southern England, several stations in Kent receiving about 1 inch. At Gorey (Wexford) also on the 30th 1 inch fell. On the 31st day temperatures again reached normal generally. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs).
Stornoway	218	+27	Liverpool	148	—51
Aberdeen	176	—11	Ross-on-Wye	129	—74
Dublin	168	—37	Falmouth	187	—44
Birr Castle	148	—34	Gorleston	168	—57
Valentia	200	— 3	Kew	152	—49

Pressure was below normal in a belt from Newfoundland across Iceland and the British Isles to southern Sweden, the deficit reaching 4·8mb. at Reykjavik. Pressure was above normal over the Mediterranean, Spain and the Azores, the excess reaching 5·0mb. at Corunna, and also in a small area in central Scandinavia. In Scandinavia temperature was above normal everywhere, the excess reaching 5°F. in Norrland while rainfall was deficient in the north but excessive in the south, southern Scania having twice the normal fall. In central Europe temperature was low and rainfall heavy.

The month has been characterised by storms and heavy rains in many parts of the world. In Switzerland and Bavaria heavy rain fell from the 7th to the 14th, and the floods on the 15th were as extensive as any in the past 20 years. The damage has been increased by avalanches, and in the Linth Valley a stream of mud and stones ten feet deep came down from the Kilchenstock Mountain, covering fields and pastures and threatening several farms. The river Isar at Munich reached five feet above flood level. On the 22nd heavy rains caused serious floods in

(*Continued on p. 128*)

Rainfall: May, 1930: England and Wales

Co.	STATION	In.	Per-cent of Av.	Co.	STATION	In.	Per-cent. of Av.
Lond .	Camden Square..........	2·67	152	*Leics* .	Belvoir Castle............	2·08	99
Sur .	Reigate, Alvington.....	2·77	152	*Rut* :	Ridlington................	2·85	...
Kent .	Tenterden, Ashenden...	3·38	215	*Linc* .	Boston, Skirbeck........	2·32	132
,, .	Folkestone, Boro. San..	3·39	...	,, .	Cranwell Aerodrome...	1·78	98
,, .	Margate, Cliftonville...	2·55	161	,, .	Skegness, Marine Gdns	1·83	108
,, .	Sevenoaks, Speldhurst	2·25	...	,, .	Louth, Westgate........	1·59	78
Sus .	Patching Farm.........	1·55	84	,, .	Brigg, Wrawby St.....	1·83	...
,, .	Brighton, Old Steyne..	2·20	136	*Notts* .	Worksop, Hodsock.....	1·22	61
,, .	Heathfield, Barklye....	2·96	165	*Derby* .	Derby, L. M. & S. Rly.	3·03	159
Hants .	Ventnor, Roy. Nat. Hos.	1·85	109	,, .	Buxton, Devon Hos....	2·87	93
,, .	Fordingbridge, Oaklnds	2·70	130	*Ches* .	Runcorn, Weston Pt...	·86	37
,, .	Ovington Rectory.......	2·47	114	,, .	Nantwich, Dorfold Hall	2·50	...
,, .	Sherborne St. John.....	1·75	90	*Lancs* .	Manchester, Whit. Pk.	1·96	92
Berks .	Wellington College.....	1·95	105	,, .	Stonyhurst College.....	2·98	105
,, .	Newbury, Greenham..	1·96	104	,, .	Southport, Hesketh Pk	1·00	48
Herts .	Welwyn Garden City...	2·50	...	,, .	Lancaster, Strathspey	1·09	...
Bucks .	High Wycombe..........	2·89	164	*Yorks* .	Wath-upon-Dearne.....	1·27	63
Oxf . .	Oxford, Mag. College..	2·01	112	,, .	Bradford, Lister Pk....	1·56	75
Nor .	Pitsford, Sedgebrook...	2·70	141	,, .	Oughtershaw Hall......	2·20	...
,, .	Oundle.....................	3·31	...	,, .	Wetherby, Ribston H.	2·22	107
Beds .	Woburn, Crawley Mill	2·91	150	,, .	Hull, Pearson Park.....	1·74	90
Cam .	Cambridge, Bot. Gdns.	3·31	188	,, .	Holme-on-Spalding.....	1·32	...
Essex .	Chelmsford, CountyLab	2·05	142	,, .	West Witton, Ivy Ho.	1·14	...
,, .	Lexden Hill House....	1·94	...	,, .	Felixkirk, Mt. St. John	1·34	71
Suff .	Hawkedon Rectory.....	3·03	164	,, .	Pickering. Hungate....	1·03	...
,, .	Haughley House........	2·36	...	,, .	Scarborough.............	1·07	56
Norf .	Norwich, Eaton.........	3·06	159	,, .	Middlesbrough..........	1·12	58
,, .	Wells, Holkham Hall	2·13	132	,, .	Baldersdale, Hury Res.	1·47	...
,, .	Little Dunham..........	3·15	162	*Durh* .	Ushaw College...........	1·27	59
Wilts .	Devizes, Highclere......	1·73	95	*Nor* .	Newcastle, Town Moor	1·29	63
,, .	Bishops Cannings.......	2·23	114	,, .	Bellingham, Highgreen	1·23	...
Dor .	Evershot, Melbury Ho.	2·49	122	,, .	Lilburn Tower Gdns....	1·38	...
,, .	Creech Grange...........	3·30	...	*Cumb* .	Geltsdale..................	1·45	...
,, .	Shaftesbury, Abbey Ho.	2·27	107	,, .	Carlisle, Scaleby Hall	1·15	48
Devon .	Plymouth, The Hoe...	2·01	97	,, .	Borrowdale, Seathwaite	4·20	57
,, .	Polapit Tamar...........	1·87	93	,, .	Borrowdale, Rosthwaite	4·04	...
,, .	Ashburton, Druid Ho.	...	...	,, .	Keswick, High Hill.....	2·16	...
,, .	Cullompton.............	1·86	86	*Glam* .	Cardiff, Ely P. Stn.....	1·54	62
,, .	Sidmouth, Sidmount...	2·19	112	,, .	Treherbert. Tynywaun	3·76	...
,, .	Filleigh, Castle Hill....	3·00	...	*Carm* .	Carmarthen Friary.....	2·35	85
,, .	Barnstaple. N. Dev. Ath.	2·36	114	,, .	Llanwrda...................	2·45	73
Corn .	Redruth, Trewirgie.....	2·04	88	*Pemb* .	Haverfordwest, School	2·27	91
,, .	Penzance, Morrab Gdn.	2·07	94	*Card* .	Aberystwyth.............	2·51	...
,, .	St. Austell, Trevarna...	3·12	129	,, .	Cardigan, County Sch.	1·86	...
Soms .	Chewton Mendip........	2·60	94	*Brec* .	Crickhowell, Talymaes	1·70	...
,, .	Long Ashton.............	1·45	...	*Rad* .	BirmW.W.Tyrmynydd	...	...
,, .	Street, Millfield	1·57	...	*Mont* .	Lake Vyrnwy...........	...	...
Glos. .	Cirencester, Gwynfa....	1·33	65	*Denb* .	Llangynhafal.............	2·31	...
Here .	Ross, Birchlea............	1·55	73	*Mer* .	Dolgelly, Bryntirion...	4·24	128
,, .	Ledbury, Underdown..	2·19	107	*Carn* .	Llandudno................	1·28	67
Salop .	Church Stretton.........	3·27	127	,, .	Snowdon, L. Llydaw 9	8·83	...
,, .	Shifnal, Hatton Grange	2·23	108	*Ang* .	Holyhead, Salt Island	1·26	64
Worc .	Ombersley, Holt Lock	2·96	144	,, .	Lligwy.....................	1·10	...
,, .	Blockley..................	2·23	..	*Isle of Man*			
War .	Farnborough.............	2·44	109		Douglas, Boro' Cem....	1·93	77
,, .	Birminghm. Edgbaston	2·07	97	*Guernsey*			
Leics .	Thornton Reservoir....	3·12	155		St. PeterP't. GrangeRd.	2·07	122

Rainfall : May, 1930 : Scotland and Ireland

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Stoneykirk, Ardwell Ho	...	...	*Suth* .	Loch More, Achfary...	5·39	122
,, .	Pt. William, Monreith	1·18	...	*Caith* .	Wick......................	1·51	73
Kirk .	Carsphairn, Shiel.......	3·13	...	*Ork* .	Pomona, Deerness......	2·68	135
,, .	Dumfries, Cargen......	...	...	*Shet* .	Lerwick..................	1·52	73
Dumf .	Eskdalemuir Obs.......	3·11	94	*Cork* .	Caheragh Rectory......	2·97	...
Roxb .	Branxholm...............	1·51	67	,, .	Dunmanway Rectory...	2·74	81
Selk .	Ettrick Manse...........	2·30	...	,, .	Ballinacurra..............	1·77	75
Peeb .	West Linton.............	1·34	...	,, .	Glanmire, Lota Lo......	2·00	82
Berk .	Marchmont House......	·95	38	*Kerry* .	Valentia Obsy..........	3·07	97
Hadd .	North Berwick Res.....	·86	43	,, .	Gearahameen.............	3·60	...
Midl .	Edinburgh, Roy. Obs.	1·22	65	,, .	Killarney Asylum......	1·41	46
Ayr .	Kilmarnock, Agric. C.	1·54	67	,, .	Darrynane Abbey.......	2·78	93
,, .	Girvan, Pinmore..	2·09	70	*Wat* .	Waterford, Brook Lo...	1·99	86
Renf .	Glasgow, Queen's Pk. .	1·64	67	*Tip* .	Nenagh, Cas. Lough...	1·52	61
,, .	Greenock, Prospect H.	2·96	86	,, .	Roscrea, Timoney Park	1·73	...
Bute .	Rothesay, Ardencraig.	2·50	82	,, .	Cashel, Ballinamona...	2·73	114
,, .	Dougarie Lodge.........	2·11	...	*Lim* .	Foynes, Coolnanes......	1·48	64
Arg .	Ardgour House.........	5·49	...	, .	Castleconnel Rec.......	1·94	...
,, .	Manse of Glenorchy...	4·82	...	*Clare* .	Inagh, Mount Callan...	3·07	...
,, .	Oban......................	2·73	...	,, .	Broadford, Hurdlest'n.	1·87	...
,, .	Poltalloch................	2·22	77	*Wexf* .	Newtownbarry	...	...
,, .	Inveraray Castle...	3·94	100	,, .	Gorey, Courtown Ho...	2·81	127
,, .	Islay, Eallabus.........	2·02	76	*Kilk* .	Kilkenny Castle.........	1·69	76
,, .	Mull, Benmore.........	4·50	...	*Wic* .	Rathnew, Clonmannon	2·43	...
,, .	Tiree	...	...	*Carl* .	Hacketstown Rectory..	2·72	105
Kinr .	Loch Leven Sluice......	1·91	78	*Leix* .	Blandsfort House......	2·05	84
Perth .	Loch Dhu................	4·30	96	,, .	Mountmellick............	2·06	...
,, .	Balquhidder, Stronvar	...	...	*Off'ly* .	Birr Castle...............	...	...
,, .	Crieff, Strathearn Hyd.	1·73	69	*Dubl* .	Dublin, FitzWm. Sq...	2·18	106
,, .	Blair Castle Gardens...	1·55	76	,, .	Balbriggan, Ardgillan.	1·62	78
,, .	Dalnaspidal Lodge.....	...	...	*Me'th* .	Beauparc, St. Cloud...	1·97	...
Angus .	Kettins School.	2·00	82	,, .	Kells, Headfort.........	1·46	54
,, .	Dundee, E. Necropolis	1·58	75	*W.M* .	Moate, Coolatore......	2·03	...
,, .	Pearsie House...........	2·12	...	,, .	Mullingar, Belvedere..	1·84	75
,, .	Montrose, Sunnyside...	...	...	*Long* .	Castle Forbes Gdns......	1·08	42
Aber .	Braemar, Bank...	1·20	50	*Gal* .	Ballynahinch Castle...	2·65	73
,, .	Logie Coldstone Sch....	1·12	45	,, .	Galway, Grammar Sch.	1·45	...
,, .	Aberdeen, King's Coll.	·99	43	*Mayo* .	Mallaranny..............	1·85	...
,, .	Fyvie Castle.............	1·25	...	,, .	Westport House.........	1·69	59
Moray .	Gordon Castle...........	1·17	55	,, .	Delphi Lodge...........	3·48	...
,, .	Grantown-on-Spey......	·91	39	*Sligo* .	Markree Obsy...........	2·18	78
Nairn .	Nairn, Delnies	1·35	75	*Cav'n* .	Belturbet, Cloverhill...	1·42	57
Inv .	Kingussie, The Birches	1·52	...	*Ferm* .	Enniskillen, Portora...	1·68	...
,, .	Loch Quoich, Loan.....	...	...	*Arm* .	Armagh Obsy...........	1·54	65
,, .	Glenquoich..............	7·31	134	*Down* .	Fofanny Reservoir......	3·84	...
,, .	Inverness, Culduthel R.	1·42	...	,, .	Seaforde..................	1·88	71
,, .	Arisaig, Faire-na-Squir	1·95	...	,, .	Donaghadee, C. Stn...	1·53	67
,, .	Fort William...........	4·11	...	,, .	Banbridge, Milltown...	1·63	...
,, .	Skye, Dunvegan........	2·67	...	*Antr* .	Belfast, Cavehill Rd...	2·00	...
R & C .	Alness, Ardross Cas ...	2·56	99	,, .	Glenarm Castle.........	2·48	...
,, .	Ullapool..................	2·40	...	,, .	Ballymena, Harryville	1·94	68
,, .	Torridon, Bendamph...	4·11	90	*Lon* .	Londonderry, Creggan	1·65	63
,, .	Achnashellach..........	5·07	...	*Tyr* .	Donaghmore............	1·66	...
,, .	Stornoway...............	2·48	97	,, .	Omagh, Edenfel.........	2·19	85
Suth .	Lairg.....................	1·99	...	*Don* .	Malin Head..............	1·05	...
,, .	Tongue....................	2·12	89	,, .	Dunfanaghy.............	1·06	...
,, .	Melvich..................	3·14	...	,, .	Killybegs, Rockmount.	1·99	55

Climatological Table for the British Empire, December, 1929.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy. ..	1005·6	— 8·1	57	29	48·2	38·9	43·5	+ 3·2	41·4	88	6·7	4·43	+ 2·14	23	2·0	26
Gibraltar............	1023·6	+ 3·5	69	43	65·2	51·0	58·1	+ 2·1	51·8	86	5·0	2·46	— 3·15	8	..	..
Malta	1018·1	+ 1·5	68	42	61·0	52·7	56·9	— 1·0	54·2	90	5·3	1·38	— 2·33	10	6·5	67
St. Helena	1012·1	+ 1·1	..	55	..	56·2	..	..	57·0	92	10·0	1·50	— 0·46	18	..	..
Sierra Leone	1011·8	+ 0·9	89	70	86·5	72·9	79·7	— 1·7	74·5	78	3·2	0·10	— 1·32	2	..	..
Lagos, Nigeria	1009·7	— 0·8	90	66	87·0	71·8	79·4	— 2·1	73·2	79	3·8	6·02	+ 5·22	2	..	..
Kaduna, Nigeria	1016·6	+ 3·8	89	..	84·7	..	..	..	64·7	77	1·2	0·00	0·00	0	..	..
Zomba, Nyasaland ..	1007·4	— 0·9	90	62	81·3	65·5	73·4	+ 0·3	..	73	6·8	10·82	— 0·05	16	..	..
Salisbury, Rhodesia ..	1007·8	— 1·4	84	53	76·1	59·5	67·8	— 1·8	62·1	71	7·5	6·59	+ 0·81	17	5·1	39
Cape Town	1013·4	— 0·9	95	44	79·2	58·8	69·0	+ 1·1	61·1	69	3·7	1·36	+ 0·55	5	..	..
Johannesburg........	1010·3	— 0·5	86	50	75·5	55·4	65·5	+ 0.4	57·6	69	4·6	5·06	— 0·37	17	8·0	58
Mauritius	1011·0	— 3·0	92	69	84·6	72·3	78·4	+ 0·1	74·8	75	8·0	22·03	+ 17·30	24	5·7	43
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	2·19	— 0·26	..	..	..
Calcutta, Alipore Obsy.	1015·0	— 0·7	84	47	76·9	57·2	67·1	+ 0·6	58·1	86	2·4	0·29	+ 0·09	1*	..	..
Bombay	1012·1	— 1·4	94	55	86·0	67·9	76·9	— 0·6	65·0	69	0·9	0·86	+ 0·81	1*	..	..
Madras	1012·2	— 1·3	85	64	83·9	70·9	77·4	+ 0·7	73·1	84	5·0	5·88	+ 0·07	8*	..	..
Colombo, Ceylon	1010·7	0·0	89	65	85·2	71·2	78·2	— 0·8	74·6	76	5·5	5·01	— 0·36	19	6·9	59
Hongkong	1017·9	— 1·8	78	44	68·8	60·9	64·9	+ 1·9	60·8	76	7·1	0·42	— 0·71	7	4:6	43
Sandakan	..	..	89	72	87·3	74·2	80·7	+ 0·6	76·9	85	..	6·98	— 10·68	9	..	..
Sydney, N.S.W.	1007·4	— 4·5	98	57	79·5	64·1	71·8	+ 1·7	64·3	60	5·9	1·87	— 1.04	12	7·9	55
Melbourne	1009·3	— 3·2	97	44	72·0	53·5	62·7	— 1·6	55·8	62	7·2	2·50	+ 0·16	15	5·2	35
Adelaide	1012·2	— 1·0	102	47	78·0	56·6	67·3	— 3·8	56·4	46	7·5	3·52	+ 2·52	5	7·9	55
Perth, W. Australia ..	1013·3	+ 0·1	100	52	82·0	60·4	71·2	+ 0·5	61·2	50	4·5	0·38	— 0·20	4	12·2	86
Coolgardie	1011·5	+ 0·3	108	45	91·3	59·1	75·2	— 0·6	58·2	32	2·9	0·00	— 0·70	0	..	..
Brisbane	1009·8	— 2·2	97	59	87·4	67·5	77·5	+ 1·1	68·8	51	4·1	1·90	— 2·94	7	9·5	69
Hobart, Tasmania....	1005·0	— 4·7	75	41	63·4	49·7	56·5	— 3·9	51·3	63	8·6	5·36	+ 3·40	19	5.5	36
Wellington, N.Z.	1004·9	— 7·3	69	43	62·7	51·5	57·1	— 3·3	54·4	76	7·5	2·67	— 0·55	16	6·3	42
Suva, Fiji	1005·9	— 2·7	89	70	83.5	74·2	78·9	0·0	74·6	77	6·9	23·91	+ 11·80	22	6·1	46
Apia, Samoa	1006·7	— 1·7	87	71	85·1	75·6	80·3	+ 1·0	77·9	82	5·9	16·84	+ 3·22	22	4·3	33
Kingston, Jamaica....	1014·5	+ 0·5	89	65	85·0	68·7	76.9	— 0·8	67·2	87	2·8	1·27	— 0·32	7	7·8	70
Grenada, W.I.	1009·9	— 1·6	89	71	86·4	73·3	79·9	+ 1·8	74·5	77	2·8	3·75	— 3·52	18	..	..
Toronto	1016·9	— 0·5	41	6	30·9	19·7	25·3	— 0·9	22·3	73	9·2	2·29	— 0·54	19	1·0	11
Winnipeg	1020·2	+ 2·3	40	—28	10·6	—2·8	3·9	— 1·8	..	..	6·4	1·45	+ 0·17	12	2·0	24
St. John, N.B.	1016·0	+ 1·8	44	— 1	28·3	15·1	21·7	— 2·7	18·4	77	7·5	3·99	— 0·18	16	2·1	24
Victoria, B.C.	1015·8	— 1·0	52	29	45·2	38·8	42·0	+ 0·5	40·4	93	8·3	4·92	— 0·99	22	1·7	20

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Climatological Table for the British Empire, Year, 1929.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L. mb.	Diff. from Normal mb.	Max. ° F.	Min. ° F.	Max. ° F.	Min. ° F.	½ max. and min. ° F.	Diff. from Normal ° F.	Wet Bulb ° F.	%	0—10	Am'nt in.	Diff. from Normal in.	Days	Hours per day	Percentage of possible
London, Kew Obsy.	1016·5	+ 1·1	87	13	57·1	42·3	49·7	0·0	43·8	86	6·6	21·39	− 2·41	131	4·7	36
Gibraltar	1017·9	0·0	91	38	71·5	58·3	64·9	+ 0·6	57·2	80	4·8	19·50	− 16·32	73	..	..
Malta	1015·9	0·0	95	39	68·9	59·2	64·0	− 2·1	59·1	77	4·4	17·47	− 2·39	90	8·4	69
St. Helena	1013·5	+ 1·9	..	52	..	56·5	..	..	57·6	94	9·2	29·76	− 10·36	230	..	..
Sierra Leone	1012·2	+ 0·8	93	..	85·5	..	..	..	75·5	83	4·4	155·15	− 2·08	164	..	..
Lagos, Nigeria	1011·4	0·0	91	66	85·7	74·7	80·2	− 0·3	75·6	82	7·7	85·82	+ 14·19	133	..	..
Kaduna, Nigeria	1015·1	+ 2·7	99	..	88·1	..	..	..	67·1	65	..	57·91	+ 8·68	124	..	..
Zomba, Nyasaland	1011·7	− 0·6	94	46	78·6	61·1	69·9	+ 0·5	..	70	5·5	58·18	− 3·64	117	..	..
Salisbury, Rhodesia	1012·2	− 0·3	95	36	76·7	54·1	65·4	+ 0·1	57·1	56	3·7	34·71	+ 2·77	94	8·2	68
Cape Town	1017·5	+ 0·5	102	38	71·3	54·8	63·1	+ 0·8	56·1	79	4·3	19·54	− 5·50	85	..	..
Johannesburg	1016·3	0·0	88	28	70·3	50·6	60·5	+ 1·0	51·2	63	3·6	34·64	+ 1·42	110	8·5	70
Mauritius	1015·8	− 0·3	92	56	79·6	67·5	73·6	− 0·4	70·1	71	5·8	70·96	+ 21·30	252	7·6	63
Bloemfontein	..	..	..	..	..	..	..	..	..	..	.	..	..	..	..	..
Calcutta, Alipore Obsy.	1007·4	− 0·2	103	47	87·9	71·7	79·8	+ 1·1	72·2	85	4·9	59·64	− 2·90	85*	..	..
Bombay	1008·6	− 0·6	97	53	87·9	74·7	81·3	+ 0·8	73·2	77	4·0	59·76	− 12·43	67*	..	..
Madras	1008·2	− 0·6	108	64	91·2	75·5	83·3	+ 0·3	75·1	75	5·2	52·42	+ 1·68	65*	..	..
Colombo, Ceylon	1010·2	+ 0·2	91	63	85·8	74·5	80·1	− 0·6	76·3	77	6·6	90·22	+ 4·97	198	7·0	58
Hongkong	1012·6	0·0	92	44	77·1	69·1	73·1	+ 0·8	68·1	76	6·8	69·82	− 14·00	122	5·9	49
Sandakan	..	..	92	72	87·5	74·7	81·1	− 0·2	77·2	83	..	120·53	+ 0·81	154	..	..
Sydney, N.S.W.	1014·8	− 1·1	106	37	70·5	56·0	63·3	+ 0·1	57·3	68	5·2	57·90	+ 10·00	129	6·9	57
Melbourne	1015·7	− 0·6	101	29	66·6	49·8	58·2	− 0·2	52·1	68	6·6	28·81	+ 3·26	172	5·3	44
Adelaide	1017·1	+ 0·1	104	35	71·8	53·0	62·4	− 0·6	53·1	52	6·1	17·51	− 3·69	119	7·0	57
Perth, W. Australia	1016·6	+ 0·2	104	38	72·6	54·7	63·7	− 0·5	56·0	60	4·9	36·77	+ 2·74	132	8·1	66
Coolgardie	1016·2	+ 0·2	109	30	76·7	50·5	63·6	− 0·9	52·7	51	3·3	10·27	+ 0·11	48	..	..
Brisbane	1015·0	− 0.8	102	40	78·3	59·4	68·9	0·0	61·8	64	4·6	39·77	− 4·89	111	8·1	67
Hobart, Tasmania	1012·0	− 0·6	93	29	61·2	46·5	53·9	− 0·4	48·1	68	7·0	26·55	+ 2·81	194	5·6	46
Wellington, N.Z.	1013·2	− 1·5	75	34	59·0	48·3	53·6	− 1·7	51·0	78	7·0	47·48	− 0·56	169	5·6	46
Suva, Fiji	1010·9	− 0·5	90	60	82·4	72·1	77·3	+ 0·3	73·3	79	6·8	148·77	+ 36·39	236	5·1	42
Apia, Samoa	1009·7	− 0·6	90	68	84·7	74·3	79·5	+ 1·0	76·6	77	4·9	108·33	+ 1·48	191	..	..
Kingston, Jamaica	1013·7	0·0	93	63	86·7	71·0	78·9	− 0·4	69·6	83	4·2	19·96	− 13·63	80	..	..
Grenada, W.I.	1009·8	− 2·4	90	69	86·1	73·3	79·7	+ 0·9	73·9	79	3·9	82·06	+ 5·98	223	..	..
Toronto	1015·9	− 0·5	92	− 3	54·0	38·0	46·0	+ 1·6	39·9	71	6·1	37·00	+ 3·53	158	5·3	43
Winnipeg	1016·5	+ 0·3	100	−30	44·8	25·3	35·0	+ 0·7	..	..	5·1	14·32	− 6·75	99	6·2	50
St. John, N.B.	1014·7	0·0	84	−12	48·9	34·1	41·5	+ 0·3	37·3	76	6·3	43·85	− 4·23	171	5·3	43
Victoria, B.C.	1018·5	+ 2·1	84	14	55·3	43·5	49·4	− 0·1	45·7	81	6·0	17·29	− 15·20	119	6·2	51

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen

(*Continued from p. 123*)

Bucharest and several other parts of Roumania, and rains are reported from southern Russia. On the 8th abnormally heavy rains fell in Ceylon, accompanying a severe gale which did much damage; the Kelani River overflowed and burst a protective dam, flooding North Colombo. The water reached the level of the housetops, three feet higher than the previous record of 1913; 15,000 persons were homeless and eleven deaths were reported.

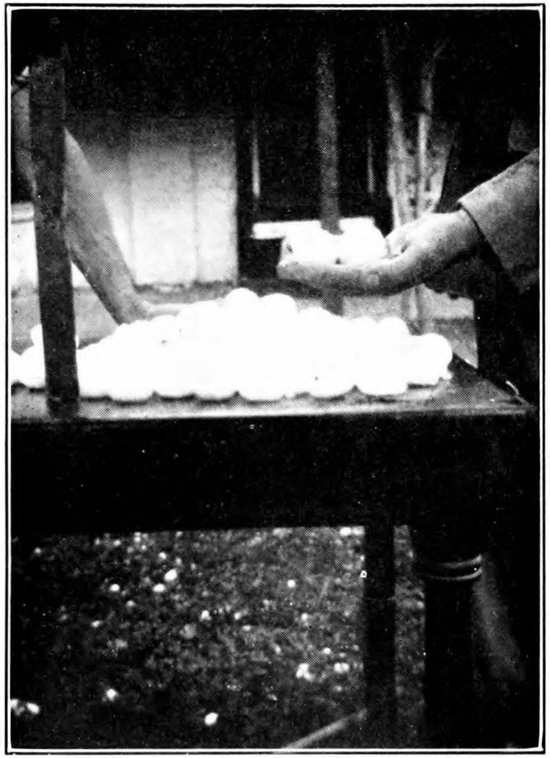
In America, on the 1st, a deep depression travelled southeastwards north of the Great Lakes, and a series of tornadoes visited the United States. Damage and loss of life occurred in Nebraska, Wisconsin, Minnesota, Kansas and Missouri. At Westby, Wisconsin, nearly every building in Main Street was destroyed. On the same day there were violent thunderstorms around New York. Still more disastrous were the tornadoes which struck several places in Texas on the 6th, resulting in the loss of 66 lives and several million dollars damage to property. During the first half of May the eastern parts of the U.S.A. suffered from drought and high temperature, but in the third week there were widespread rains, which were beneficial throughout the Atlantic States but were too heavy in the Mississippi valley. On the 16th to 18th three days of continuous rain flooded more than 50 square miles in southern Arkansas, Texas, Oklahoma and Louisiana; the Washita River at Camden reached a flood level of 30 feet and the Red River in Arkansas and Texas washed away bridges and flooded roads and railways. At Waco, Texas, 13in. of rain fell in the three days. The last week of the month was cooler, and snow fell in several parts of western Canada.

In the Argentine the first half of the month was generally warm and rainy, the third week was cool and rainy, and the fourth week warm and dry. In Australia abundant rains were reported on the 8th to 12th over the wheat belts of the south and east, including the dry north-west Mallee, to the great benefit of the farmers.

The special message from Brazil states that the rainfall in the northern regions was 1·81 in. below normal, and in the central and southern regions irregular, the averages being 0·39 in. above normal and 0·04 in. below normal respectively. Four anticyclones passed across the country and the continental low-pressure area persisted. All the crops except cocoa were still suffering from the lack of rain. At Rio de Janeiro pressure was 1·5mb. above normal and temperature very slightly above normal.

Rainfall, May, 1930.—General Distribution

England and Wales	107	per cent of the average 1881-1915.
Scotland	79	
Ireland	76	
British Isles	94	



Hailstones at Hinaidi, Iraq, April 24th, 1930
(see p. 143).

Trees damaged by lightning, near Paris,
July 24th, 1929 (see p. 138).

M.O. 326.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 65
July
1930
No. 774

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: Adastral House, Kingsway, London, W.C.2; 120, George Street, Edinburgh; York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 15, Donegall Square West, Belfast; or through any Bookseller.

June Thunderstorms

By C. K. M. Douglas, B.A.

There was a spell of thundery weather from June 12th to 19th, culminating in widespread and severe storms on the 18th. Pressure during the period was high from Scandinavia to the Azores, low round south Greenland, and relatively low on the continent, where thunderstorms were numerous. From the 12th to the 14th the storms over England were local and not as a rule severe, and on the 15th conditions were fine and anticyclonic. On the 16th the continental depression spread definitely northwestward, and on the 17th and 18th there was a shallow belt of relatively low pressure over the British Isles, dividing the anticyclone into two portions—a typical thundery situation. The renewal of the thundery weather was heralded on the 16th by a falling barometer and by large quantities of high and medium clouds, including alto-cumulus castellatus, moving from the southeast, over a northeast wind at lower levels. Some showers fell on that day from a high level, and during the following night and early morning thunderstorms occurred near the east coast from Kent to Spurn Head. These storms were associated with the replacement of cool North Sea air by warm air coming over from the continent, forming a "warm front." By next day the warm air covered a considerable area, and the solar heating raised the temperature to near 80° F. Severe thunderstorms broke out in the afternoon, notably over London, Westminster having 60 mm. of rain. Next day

(90254) P.S. 14/89 1,050 7/30 M. & S. *Gp.303*

(June 18th) the storms developed over a larger area, extending to southern Scotland and Wales. Cheltenham recorded 90 mm. and Greenwich 67 mm. There were several deaths from lightning. The Ascot racecourse was flooded and racing was abandoned for the first time on record. The only considerable part of England which escaped was the southwest and the neighbourhood of the south coast. (The upper wind drift was from a southerly point on both days, but was too slight to bring across the French thunderstorms, so that the strip within 30 or 40 miles of the south coast escaped.*) The worst storms on the 18th occurred at the fringe of a cooler southwesterly current, under-cutting the warmer air, which afterwards spread over the country and brought the thundery weather to an end.

Upper air observations at Duxford showed the typical thundery conditions, namely, an adequate moisture supply and a lapse-rate of temperature slightly above the saturated adiabatic through a great range of height. The upper air temperatures were practically identical on the 17th and 18th, and were well above the normal for June, the excess being 10° F. at 5,000 feet and 8°F. at 16,000 feet. Upper wind observations showed that there was a mass movement of the air at all levels from the southeast, bringing over continental air, presumably already in the thundery state. Thunderstorms had been widespread and severe on the continent for some time past. In such prolonged thundery spells there must be some means of maintaining the moisture supply, for though some of the rain is re-evaporated, much of it must run off. The necessary supply is doubtless maintained by the convergence of the surface winds into the low-pressure area, due to friction with the ground. Since the water content of the atmosphere almost always decreases upwards, convergence at the bottom is a very effective means of maintaining or increasing the total water content over a given area. Observations of both the surface and the upper winds provide no evidence that there was any inflow of Atlantic air during the period June 12th to 18th. The converging air was all continental, except for a little from the North Sea.

The intensity of the storm of June 18th in the Royston district was to some extent demonstrated by the unpleasant experience which I had whilst returning by road from Essex on that afternoon.

We ran into heavy rain just before reaching Royston, and after passing through Royston the downpour became torrential. About a mile from Royston and at about 2.45 p.m. B.S.T. my engine stopped—I believe this was due to the suction of the fan drawing water through the radiator on to my plug leads, as

---

*See "A Problem of Convection," *Meteorological Magazine*, 64, 1929, p. 213.

after the elapse of about 10 minutes the engine fired and I was able to proceed again.

Meanwhile four cars came to a standstill behind mine. Also during this period the electrical display was decidedly impressive, and I witnessed for the first time of my life a "ball discharge." The ball appeared to be the residual of a flash and descended at about an angle of 45° to the horizon, finally coming to rest at what appeared to be the height of the top of a telegraph pole some 300 or 400 yards distant along the railway line (L.N.E.R.). The ball illuminated the district much in the manner one would expect from a large magnesium flare, and remained brilliant for apparently several seconds. It then decreased in brilliance, and after a brief period during which it exhibited a red glow it died out completely. Several other lightning discharges took place shortly afterwards and, judged by their intensity, they were unpleasantly close.

At about 2.55 p.m. I was able to proceed, but in another mile or so my engine stopped again and I was again forced to wait—probably until the heat of the engine had dried the plug leads.

N. H. SMITH.

An Investigation of the Statistical Probability of Rain in London

By D. DEWAR, B.Sc.

IN order to investigate the statistical probability of rain of various amounts in London, the hourly tabulations of rainfall from Kew Observatory for the 50 years 1872 to 1921 were analysed as follows. The month was divided into three periods, 1st-10th, 11th-20th, 21st-end of month, and each day into four quarters or intervals of 6 hrs (1 a.m.-7 a.m., 7 a.m.-1 p.m., 1 p.m.-7 p.m., 7 p.m.-1 a.m.), which are referred to as the "early morning," "forenoon," "afternoon," and "night" intervals, respectively. Allowance was made for the fact that the last period of the month does not usually consist of 10 days. The total amount of rain which fell during each of these intervals of the day was noted, and the interval classified as "A" if 0·04 inch or more was recorded, "B" if 0·02 or 0·03 inch, and "C" if 0·01 inch. On occasions when snow had fallen and had not been autographically recorded, the total amount was distributed evenly over the hours during which it was presumed it had fallen. On several occasions, dew or melting frost had deposited an amount "C" in the check gauge; these were disregarded so as not to bias the 7 a.m.-1 p.m. interval in favour of that particular amount.

The results were then summarised by finding the number of occasions during the 50 years on which rain of a given amount fell in a given interval; the probability of rain of that amount in that interval was then found by dividing the number of occasions when it occurred by the number of occasions when it could have occurred. This investigation, which is being carried out at the suggestion of Colonel Gold, will require some time to complete, but it was thought that the results obtained for January were of sufficient interest to warrant their being published. The probabilities of rain of each amount, during each interval of the day, for each of the three periods of the month were found in this way, and are given in Table I :—

TABLE I.—PROBABILITY OF RAINFALL OF DIFFERENT AMOUNTS.

Time	Forenoon (7 a.m.—1 p.m.)			Afternoon (1 p.m.—7 p.m.)			Early Morning (1a.m.—7 a.m.)			Night (7 p.m.—1 a.m.)			mean
Amount	A	B	C	A	B	C	A	B	C	A		C	A
Jan. 1-10	·126	·052	·064	·136	·050	·036	·134	·046	·060	·130	·064	·038	·132
,, 11-20	·108	·056	·048	·096	·060	·038	·086	·048	·048	·110	·046	·030	·100
,, 21-31	·078	·049	·047	·118	·062	·036	·105	·044	·036	·078	·064	·038	·095
Mean	·104	·052	·053	·117	·057	·037	·108	·046	·048	·106	·058	·035	

Amount—A = ·04 inch or more
B = ·02 or ·03 inch
C = ·01 inch

These figures reveal several interesting facts.

The probability of rain of amount "A" in each of the four 6-hour intervals during the first 10 days of January is considerably in excess of that for the next two 10-day periods. The excess is so marked that there is a reasonable presumption of reality: out of 2,000 6-hour intervals in each of the 10-day periods in the 50 years considered, there were 263 wet (A) intervals in the first 10 days of January, compared with 200 such intervals in the second 10 days and 188 in the last 10 days (adjusted from the number in the last 11 days, viz., 206).

From columns 2 and 11 of Table I it will be seen that there is a remarkable parallelism between the probability of rain of amount "A" in the forenoon interval (7 a.m.—1 p.m.) and the night interval (7 p.m.—1 a.m.), and from columns 5 and 8 between the afternoon interval (1 p.m.—7 p.m.) and the early morning interval (1 a.m.—7 p.m.), that is, at 12-hour intervals.

Rain of measurable amount in a 6-hour interval falls on about one day out of five: rainfall of 1 mm. or more (amount "A") occurs on about one day out of nine. If the figures for the morning and afternoon are put together they show that even in January the odds are more than four to one against an appreciable amount of rain (1 mm. or more) falling during the working day (7 a.m.-7 p.m.) in London.

On the whole, the chance of slight rain (amount "C") is greater in the early morning and forenoon than in the afternoon or evening.

Cold Fogs over the Sea

On the morning of May 1st, 1930, it was noticed that the temperature during a fog at Inchkeith, in the Firth of Forth, was surprisingly low, considering that the wind was blowing in from the open sea. The temperature was 49°F. at 1h. and 38°F. at 7h. G.M.T., and was considerably lower than that of any air which had entered the North Sea during the previous few days. The mean sea temperature off east Scotland is 43°F. in April and 48°F. in May. Similar cold sea fogs have been observed before, a conspicuous case occurring at Yarmouth on March 12th and 14th, 1929. On the first of these dates the temperature was 32°F. at 7h., and on the second 33°F., with a light wind off the sea on each occasion. On the 14th the maximum at Yarmouth and other east coast stations was only 36°F. The inversion was very large, the temperature at Duxford being 49°F. at 2,190 feet, and 52°F. at 3,650 feet. The temperature of the North Sea was unusually low in March, 1929, but even if it was 6°F. below normal and only 36°F. off Yarmouth, it was higher than the morning temperatures noted above.

The most likely explanation seems to be that radiation from the upper surface of the fog may sometimes influence the temperature even at the bottom of the fog. Even if we started with an inversion within the fog itself, caused by cooling over a sea or land surface, radiation from the upper surface of the fog (assuming no further cooling at the bottom) would produce convective equilibrium or instability within the fog, and an inversion above it. Soundings at Kew Observatory have shown that fogs which have lasted for some time have inversions above them rather than within them. At the daily conference in the Forecast Room of the Meteorological Office on May 1st, Col. Gold suggested making an estimate of the outward radiation from the fog, on the assumption that the net loss was a quarter of the radiation from a black body, the remaining outward radiation being balanced by the downward radiation from the sky. At a temperature of 278°A. (41°F.) the full radiation is ·49 gm. cal. per sq. cm. per minute, a quarter of this being ·12. The remaining ·37 is about equal to the mean sky radiation observed in April in southeast England. Suppose the fog to be 150 metres thick, then allowing for the latent heat of condensation a loss of ·12 cal. per sq. cm. per min. could cool the entire mass 1·0°C. per hour. This figure seems on the high side, and the assumption that even a thick fog radiates like a black body may not be correct. If the fog radiated and absorbed like a grey body, so that some of the sky radiation passed right through it, all the figures given would have to be reduced in the same proportion. This reduction might be large in the case of thin fog, but should be small for a dense fog. Scattering also requires consideration, but one would not expect this to be large for long-wave radiation. Thus the order of magnitude of the figures given is probably correct.

After convective equilibrium had been established in the fog as the result of the radiation from its upper surface, the temperature at its lower surface would fall below that of the sea, and a transfer of heat from the sea to the air would commence. If this took the form of radiation only, and the sea and the fog radiated as black bodies, while the downward sky radiation remained constant at ·37, a balance between the gain of heat at the bottom of the fog and the loss at the top would not be reached till the fog was 9°C. (16°F.) colder than the sea, assuming a sea temperature of 280°A. (45°F.). This figure is excessive, and it is evident that turbulence is the main factor in diffusing up the heat from the sea surface. The best expression for the eddy flux of heat is that given by D. Brunt,* namely,

$$K\rho c_p \left(\frac{dT}{dz} + a\right),$$

where K is the coefficient of eddy diffusivity, ρ the air density, and c_p the specific heat of air at constant pressure. The expression in the bracket is the difference between the observed lapse-rate of temperature and the adiabatic rate, the flux being upwards when the adiabatic rate is exceeded. In the case of foggy air we may take the saturated adiabatic rate, if we neglect the fall of the fog particles through the air. Unfortunately there are too many unknown factors for a complete solution of the problem. The observed fact is that the air temperature at the height of a few metres is sometimes a few degrees colder than the sea, though never much colder. If a balance is reached with a difference of 2°C., the upward radiation flux is only about ·02 cal. per sq. cm. per min., and if the loss at the top of the fog is ·12, we require an eddy flux of ·10 to make up the balance. If we take $K = 10^4$ sq. cm. per sec., a a value of $\left(\frac{dT}{dz} + a\right)$ equal to 6°C. per 100 metres gives the required amount of flux. This involves a lapse-rate much above the adiabatic, which could not exist through a large thickness of the atmosphere, but which might exist within a few metres of the surface. Such lapse-rates are normal within a few metres of a land surface in the middle of the day,† and the fact that the air temperature on ships is often some degress colder than the sea temperature seems to show that they also exist over the sea.

---

*The Transfer of Heat by Radiation and Turbulence in the Lower Atmosphere. *London. Proc. R. Soc., A.*, 124, 1929, pp 201 - 18.

†See "A Study of the Verticle Gradient of Temperature in the Atmosphere near the Ground." By N. K. Johnson, *London. Meteor. Office, Geoph. Mem., No.* 46 (M.O. 307 f.).

A persistence of such conditions involves the curious anomaly that K is smaller in the region of excessive lapse-rate than it is a little higher up, with a lapse-rate about equal to the adiabatic. This must be due to the small size of the eddies near the surface of the land or sea. The flux of heat mentioned above can of course also be obtained with a smaller lapse-rate and a higher K. A flux of that order of magnitude seems to be indicated by the rate of warming of cold air currents over warmer seas in normal conditions, when the heat is diffused up to a kilometer or more.

Turbulence in a fog layer would not necessarily be visible to an observer under it, but it should affect the upper surface. I have on several occasions seen fog layers resembling typical strato-cumulus clouds when viewed from above. The turbulence would of course normally thicken the upper part of the fog at the expense of the lower part.

Sometimes land fog in winter drifts over the English Channel and persists, as on February 11th to 16th, 1927, when shipping was seriously delayed. Some time ago I examined some temperature records from Portland Bill Lighthouse, where the fog prevailed for most of the period, comparing the screen readings with those of a thermometer outside a window near the top of the lighthouse. The exposure of the latter thermometer was unsuitable for accurate comparisons, but on the occasions in question the difference was so large that it is certain that the lapse-rate exceeded the dry adiabatic. Radiation from the fog seems the only reason for its failure to dissipate in mid-Channel.

I have had the advantage of discussing the matter with Colonel Gold.

C. K. M. DOUGLAS.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, June 18th, at 49, Cromwell Road, South Kensington, Mr. R. G. K. Lempfert, C.B.E., M.A., F.Inst.P., President, in the Chair.

C. E. P. Brooks, D.Sc., and S. T. A. Mirrlees, M.A.—Irregularities in the Annual Variation of Temperature in London.

The late Dr. A. Buchan enumerated six cold and three warm spells which recurred about the same dates in each year in Scotland in the 1860's. To find whether these or similar spells occurred also in London, averages of temperature at Kew Observatory were found for each of the periods 1871 to 1900 and 1901 to 1929, and were combined into five-day means, a "spell" being defined as a period of five days. The details of the curves of annual variation obtained in this way were almost completely different in the two periods, and do not give the slightest support to the idea that there is any abiding tendency for any part of the year to be either cold or warm for the season. In particular, the famous " Buchan cold periods " are abnormally warm as often as they are abnormally cold. The nearest approach to a regular cool period occurs in summer, when the annual rise of temperature ceases towards the end of July and gives place to a period of variable temperature which continues until the autumn fall sets in about the middle of August; but none of these oscillations occur with sufficient regularity to enable us to pick out any special dates as definite warm or cold periods. Throughout most individual years temperature rises and falls so rapidly that whatever dates are selected a cold spell can be found a few days before or after, and to an uncritical mind this verifies the existence of a cold spell on the selected dates. On the other hand it would be as easy to " prove " the existence of a warm spell on the same dates. Two interesting features were brought out by the curves: since 1900 winters have been on the whole abnormally warm, and there has been another period of high temperature during the last ten days of May. Neither of these tendencies existed between 1871 and 1900, and there is no reason to expect that they will continue indefinitely in the future.

The paper was followed by a good discussion, in which the method of smoothing over five days was criticised as masking cold and warm spells which covered only one or two days. The suggestion was made that Buchan's results had been generally accepted because though in many years marked cold or warm periods did not occur, yet when they did, they tended to fall on or near Buchan's dates. On the other hand, Mr. Mirrlees thought that the belief had persisted because meteorologists had been more interested in explaining the existence of cold and warm periods than in finding out whether they did, in fact, exist.

C. E. P. Brooks, D.Sc.—The Climate of the First Half of the Eighteenth Century.

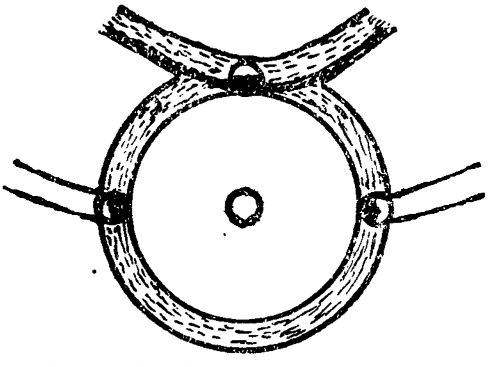
Is our climate changing? The answer seems to be that there has been no appreciable change since 1750, but there is much evidence that the first half of the eighteenth century was abnormally dry in western Europe. Rainfall figures are discussed for 29 places, and the average deficiency of rainfall is calculated as 7 per cent. in England, 15 per cent. in France and 9 per cent. in Russia and Sweden. South-westerly winds were less frequent than now and north-easterly winds more frequent; the area of low pressure near Iceland was therefore probably less intense than at present. The deficiency of rain was greatest in the south of France, while Italy and Tunis were wetter than now, suggesting that the stormy area in the Gulf of Lions was highly developed. The inquiry is extended to other parts of the world; the slow growth of the "big trees" shows that rainfall was slight in western United States of America, and the Lake of Mexico was at a low level, but the Caspian Sea and the Nile floods were high, and there were many floods in China. All these facts agree that the general atmospheric circulation, which governs the rainfall of western Europe and California, was weak; the southerly monsoons of Abyssinia and China, which override the general circulation, were abnormally strong and brought heavy rainfall to those countries.

Correspondence

To the Editor, *The Meteorological Magazine.*

Halo Phenomena

On May 1st a prismatic solar halo of 22° became visible about 14h. continuing to sunset. A bright prismatic mock sun developed on the halo to the left of the true sun about 17h., and a white mock sun to the right shortly afterwards. The mock sun ring was visible outside the halo, curving slightly upwards, but was not continued through the true sun. At 18h. an upper contact arc with a third mock sun developed, the complete phenomenon being shown in the attached figure. A pink sun pillar about 10° in height was seen at 19h. 15m.



Although the formation is not a very uncommon one, in the present case it was exceptionally complete, and the prismatic colouring of unusual intensity, the red and green of the upper contact arc being vivid, and was continued after the sun had set. No coloration was observed in the extended arcs of the mock sun ring which remained white throughout. The same evening at 22h. a lunar halo of 22° with a single mock moon was observed. On May 5th, about twenty minutes before sunrise, 4h. 26m., the top arc of a very bright prismatic solar halo was visible. There were some indications of thin cirri over the sky, but the sun's disc, pink in colour, was sharp at sunrise without any indication of blurring. This halo remained visible to 14h. All times are G.M.T.

Worcester Park, Surrey. SPENCER C. RUSSELL.

At 9h. (G.M.T.) on May 1st, I observed at Bagshot, Surrey, part of the halo of 22° and one "mock-sun." It was faint and of a whitish colour.

At 17h. 55m. on the same day I saw the halo of 22° at Bagshot, complete except for one small portion which was broken off by the horizon. The two parhelia and the halo were quite brilliant, and showed prismatic colouring. The sky was covered with thin cirro-stratus.

G. D. Waterer.

Wellesley House, Wellington College, Berks. May 6th, 1930.

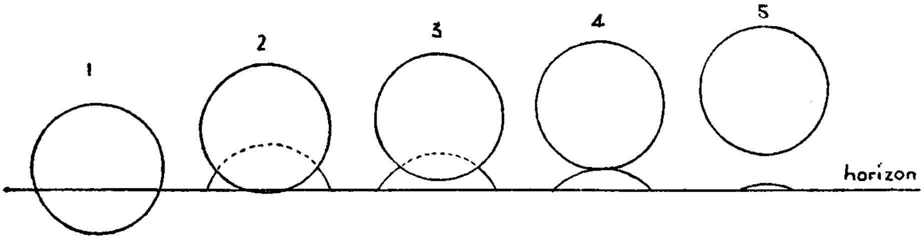
On Sunday evening, June 15th, between 8.30 and 8.45 p.m. (S.T.) parhelia were observed, no halo was visible, but the prismatic colours at the points of illumination were seen. At 9 p.m. the parhelia faded, but a sun pillar appeared for a few minutes.

Robert Gray.

Oaklands, Dorstone, Herefordshire. June 14th, 1930.

Inferior mirage at Sunrise?

While waiting for the ferry to India, at Talaimannar, last Friday, March 28th, I saw the sun rise over the sea to the east, about 6.15 a.m. As its lower edge rose above the horizon, it seemed, as a member of our party expressed it, as if the sun were dragging another sun out of the sea. After a few seconds, this mock sun, when a part only of its diameter had risen to sight, separated from the real sun, and appeared to sink again to the horizon.



I should imagine that this was a case of inferior mirage, the phenomenon actually taking place as shown in the diagram. Stages 2 and 3 would be obscured by the glare from the sun, which was appreciable, and this and the unexpectedness of the phenomenon would explain the illusion of the dragging upwards of the image.

H. Jameson.

Colombo University. April 2nd, 1930.

Trees damaged by Lightning

Whilst reading the *Meteorological Magazine* of July, 1929, I was interested in the photo of the elm tree struck by lightning at Chorley Wood.

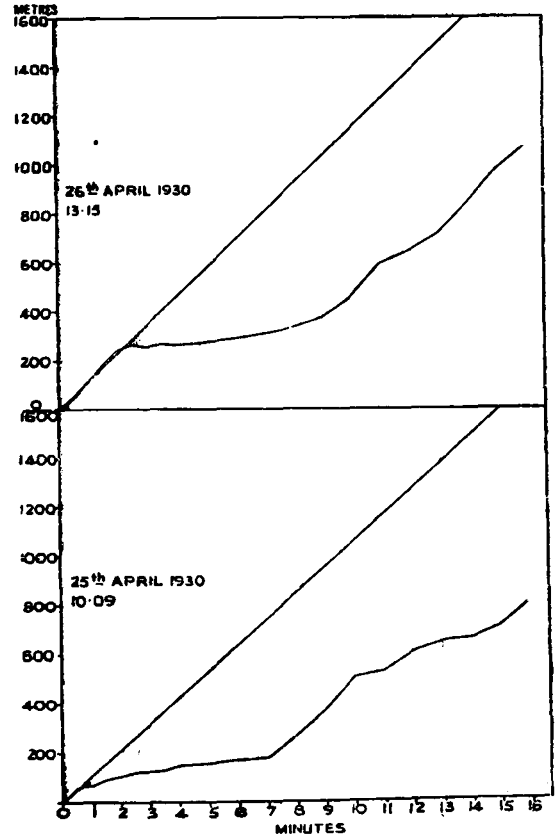
On July 24th, 1929, I was on holiday in France and stayed one night at Chalons-sur-Marne. Between 7 p.m. and 9 p.m. there was a violent thunderstorm accompanied with heavy rain and wind. Next morning on leaving for Paris, I passed, in a distance of thirty kilometres, twelve or more trees which had been struck by lightning in the manner shown in the photo which forms part of the frontispiece of this number of the magazine. The bark from these trees was strewn across the road, and many of the trees were split into halves.

A. H. WHITE.

London Road, North End, Portsmouth. August 24th, 1929.

Downward Air Currents

I am enclosing a couple of graphs showing the vertical movement of pilot balloons as measured here by the tail method on April 25th and 26th. Horizontal movements were in all cases concerned between southwest and west, and velocities were fairly uniform and did not exceed 5 metres per second on the 25th or 6 metres per second on the 26th. As the vertical angles concerned were mostly between 10° and 20° the low heights cannot be explained away as due to the tails not being vertical, while the possibility of a leak in the balloon is negatived by the almost normal rate of ascent between the 7th and 10th minutes on the 25th and from the 13th minute onwards on the 26th. The graphs are pretty definite in showing that for two consecutive flights the downward movement of the air in the neighbourhood of 300 metres altitude was sufficient to cancel the balloons' own buoyancy over a period of several minutes.



ALTITUDES OF PILOT BALLOONS AS OBSERVED AT COLOMBO TOGETHER WITH THE THEORETICAL ASCENT AS DEDUCED FROM FREE LIFT AND WEIGHT.

This fact is interesting in itself, but possesses added interest in connexion with what followed it. I have pointed out previously that a monsoonal advance has a tendency to drive the air in front of the lower half of it downwards as well as forwards, owing to the wave front of such an advance not being vertical, but more advanced at the level of maximum velocity than at the surface (*Q.J.R. Meteor. Soc.* 55, p. 373) and have frequently noticed that such downward movement, as indicated by the pilot balloons, has been followed by increased monsoonal activity, not immediately, but within a couple of days. April 27th is rather early in the year for pure monsoonal effects, but not too early for the composite effects connected with its earliest stages, and in this case the meteorological history of the few days following these low vertical velocities has been most significant.

From the 24th to the morning of the 28th the rainfall at Colombo was only 0·05in. On the night of the 27th-28th the wind was light or moderate, but remained in the southwest quadrant all right for the first time this year. This is one of the recognised milestones in the early development of the monsoon and occurred eleven days earlier than it did last year.

What probably interested the public was the aftermath of this premature attempt of the monsoon to take charge, on the night of the 28th, a wind velocity of 66 miles per hour was recorded with 4·21 inches of rain. This was certainly not a pure monsoon effect, but equally certainly in the category referred to above as a composite effect connected with it. A pure intermonsoon convectional thunderstorm might have given the rain, but hardly the wind velocity, which was from the east.

A. J. Bamford.

Colombo Observatory, Colombo. May 6th, 1930.

NOTES AND QUERIES

The Effect of Exposure on Climate

In the *Meteorological Magazine* for May, 1929, attention was drawn to Dr. Geiger's account of meteorological investigations carried out on the Hohenkarpfen in the Swabian Jura. In a further paper* the effect of wind velocity upon the skin of air covering the hillsides is discussed. The temperature gradient in the early afternoon between 25 and 100 cm. above the ground (based upon observations on the summit and at eight places about half-way up the hill) is shown to decrease with increase of wind in cloudy or overcast weather. In clear weather, however, the gradient is less with so-called " moderate " than " light " winds while with " strong " winds it is greater. The words " moderate " and " strong " are applied to winds of average velocity 3·4 and 5·9 m./s. respectively, which is rather misleading—apparently only light and moderate winds are included. It is argued that in fine weather the whole skin of air becomes more uniformly warm but with increasing winds (5·9 m./s.) the top part of the skin is more disturbed than the bottom so that the temperature gradient increases somewhat within the first metre. Taking all cases together and the temperature gradient with winds of average velocity 2·2 m./s. as a standard, the gradient is shown to decrease only 9 per cent. with winds of 3·4 m./s. and 19 per cent. with those of 5·9 m./s.

---

* Messung des Expositionsklimas. *Forstwiss. Centralbl. Berlin,* 51, 1929 pp. 305-15.

In this, the last paper but one of the series the author turns from the discussion of averages to isolated cases and describes two thunderstorms which occurred on May 16th, 1926. The first and minor storm was experienced in misty weather with a cold NE. wind at surface below a warm SE. current which had come over the top of the Swabian Jura. The second storm was caused by the down-rush of still colder air which, owing to the masses accumulated by northerly winds in the Rhine valley between the Swiss Jura, the Vosges and the Black Forest, had been forced over some of the lower ridges of the Black Forest and approached the Hohenkarpfen as a SW. wind. The distribution of wind and rainfall on the various slopes of the hill is discussed, the strongest winds occurring on the northwest and southeast slopes (*i.e.*, on the flanks relative to the wind direction) in accordance with the normal distribution mentioned in an earlier paper. A further example of the wind distribution is contained in an account of the storm of June 12th, 1926, which appears in the ninth and last paper of the series.* On the western sides of the hill the force of the wind at its maximum was two to three times as great as on the eastern sides.

The last paper also includes a discussion of the distribution of rainfall in five thunderstorms during the period of investigation and an interesting account of the diurnal and other variations of wind velocity on different parts of the hillsides. The relation between the force of the wind in normally quiet weather and that in rough conditions is shown in a diagram to indicate the liability to damage by storm.

The work concludes with a brief recapitulation of the results of the investigations, the pages on which each point is discussed being clearly stated.

Observations in the Sahara

An interesting set of observations has been communicated to the Meteorological Office by Dr. T. F. Chipp, Assistant Director of the Royal Botanic Gardens, Kew. Dr. Chipp, who had been attending a conference in Algiers, took part in an expedition to the western Hoggar (or Ahaggar) district of the Sahara.

---

* *Ibid.* 51, 1929, pp. 637-56.

about 1,000 miles south of Algiers, and obtained a number of meteorological observations at various points on the route between Fort Miribel and Tamanrasset and in the western Hoggar near Abelessa and Silet. A whirling hygrometer was used thrice daily on several days, maximum and minimum thermometers were set up when possible, and frequent observations of wind and sky conditions were made.

Dr. Chipp's results are probably fairly representative of conditions during March, 1930, in an area centred about lat. 23° N. long. 4½° E., at a height of about 3,000 feet above sea level.

Mean time of observation	6½h.	13h.	18h.
Mean temperature (°F)	57	84	76
Mean relative humidity (per cent)	33	14	16

Mean maximum 90°F. Mean minimum 51°F.

In this table, the humidities given were computed with Pernter's "strong wind" formula, which is probably appropriate for readings of a whirling hygrometer in these conditions.

Winds were rather variable, mainly north-easterly in the first half of the month. Cloudiness, while small, tended to increase during the day, the average figures, based on numerical values assigned to such descriptions as "cloudy," "few clouds," "overcast," being, for the morning observation, less than one-tenth, afternoon two-tenths, evening four-tenths. Heavy thunderstorms with much rain were experienced from 6h. to 8h. on March 2nd, while the expedition was on the Plateau de Tademait.

Meteorological records from the Sahara are uncommon, but it so happens that there are other observations with which those of Dr. Chipp may be compared. In March, 1923, the Olufsen expedition was travelling northwestward from Tamanrasset, and the results for that period are as follows:—

Hour of observation	6h.	14h.	20h.
Mean temperature (°F)	57	89	71

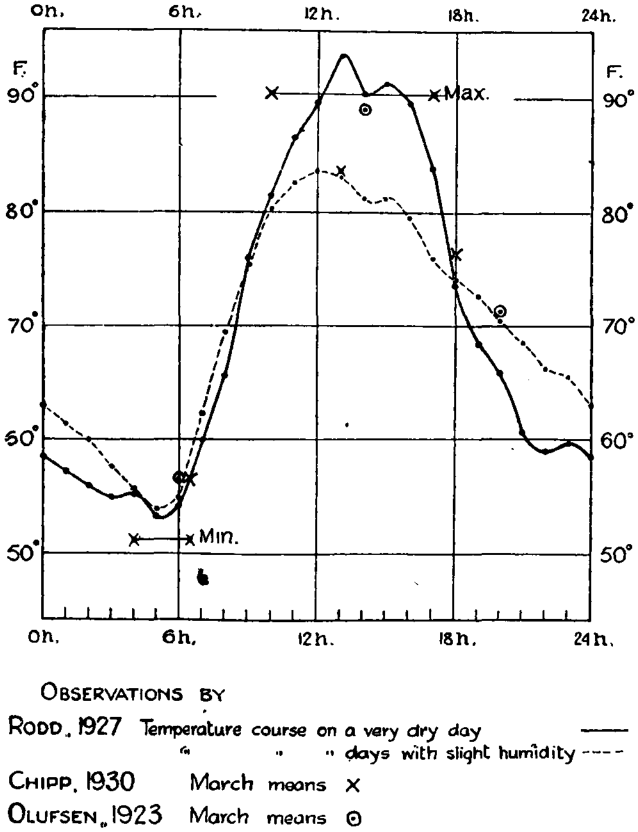
These figures may be taken as applying to an area centred about lat. 25° N., long. 2° E. Values of relative humidity are not given, as it is not known what formula was used in the reduction of the observations. We have no direct observations of the complete diurnal course of temperature in this part of the Sahara, but the general type may be assumed to be similar to that found in neighbouring parts. In Fig. 1 an attempt has been made to compare the two sets of observations by the use of thermograms obtained by Mr. F. R. Rodd* in the Aïr region, about 500 miles southeast of Tamanrasset.

The dotted curve represents temperature variation on a November day, and may be taken as typical of a day when the amount of moisture in the air is exceedingly small. The plain

---

*See *London, Meteor. Office Geophysical Memoirs, No.* 48.

curve is intended to show conditions when the amount of moisture in the air is more appreciable; it is the mean curve for several days in September, displaced about 20° down from its true position to bring it into range with the other observations. It shows the same sharp rise in temperature during the morning, but a more rounded afternoon maximum than that of the very dry November day. It will be seen that apart from one discrepancy the observations of the more northern expeditions agree quite well with the type of diurnal variation observed in the southern Sahara, while the two sets of morning observations are in remarkably good agreement. The discrepancy is between Dr. Chipp's figures for 13h. and maximum temperatures. One must accept the observations of the whirling hygrometer as reliable, and the probable explanation is that the exposure of the maximum thermometer was in some way defective. Possibly the readings of the minimum thermometer also are slightly affected; Olufsen's 14h. readings certainly agree well with Dr. Chipp's maximum, but it is not known how the thermometers of the former were exposed. The question of the reduction of psychrometer readings made in conditions of such extraordinarily low humidity is a vexed one; Olufsen's view is that when one gets to the region of 12 per cent. one should enter "less than 12 per cent.," rather than any lower figure.



Remarkable Hailstorm in Iraq

The report of the Meteorological Section in Iraq for April, 1930, contains an account of a remarkable hailstorm which visited Hinaidi and Bagdad on April 24th. On the morning of that day the weather conditions were unsettled, the morning chart showing a primary depression extending eastwards along the eastern Mediterranean into Syria and a secondary depression south of Rutbah. The primary depression moved slowly north-eastwards, but the secondary travelled rapidly eastwards across western Persia. At Hinaidi the morning began with light north-east to east winds, which became calm at 3h. G.M.T. (6 a.m. local mean time). At 3h. 35m. a line-squall occurred, the wind reaching a velocity of 36 m.p.h. and veering from south-east to west. A second line-squall followed at 4h. 34m., in which the wind rose to 30 m.p.h. and veered from north-west to north-east. Subsequently the wind gradually became more easterly and maintained an average velocity of 32 m.p.h. At 14h. 15m. G.M.T. slight rain commenced, and at 14h. 30m. the wind began to drop to calm and a heavy fall of hail occurred, continuing for seven minutes. The most remarkable features of the hail-storm were the large size and slow terminal velocity of the hailstones and the absence of dust in their composition. Some idea of their size is given by the illustration forming part of the frontispiece of this number of the magazine.

An average specimen was cut open and was found to consist of five layers of alternating hard transparent ice and soft white ice, arranged as follows:—

Core of hard transparent ice	$\frac{1}{8}$ inch diameter.
Layer of soft white ice	$\frac{1}{4}$ inch thick.
Layer of hard transparent ice	$\frac{1}{8}$ inch.
Layer of soft white ice	$\frac{1}{4}$ inch.
Outer crust of hard transparent ice ...	$\frac{1}{8}$ inch.

The total diameter was one and five-eighths inch, and in calm air the terminal velocity of hailstones of this size would be nearly 30 miles per hour. The descent of several specimens was actually timed against the wall of a building, and it was found that they fell 40 feet in about three seconds, giving a velocity of only 9 miles per hour. The observer is to be congratulated on his enterprise in obtaining this measurement, which appears to indicate an upward current of air of at least 30 m.p.h. at a comparatively low elevation.

Hailstones which fall in Iraq usually contain about 25 per cent. of dust, but those of April 24th appeared perfectly clean, even when examined through a lens.

A Peculiar Deposit at Southport

During the night of March 8th—9th a singular yellowish brown substance was deposited from the atmosphere in the neighbourhood of Southport. Subsequently, Mr. J. Baxendell forwarded for examination a number of objects bearing traces of the deposit, and stated that " early on the 9th objects looked as though coated with ochre, but rain spoiled it." Dr. J. S. Owens reported that when examined under the microscope the deposit was found to consist of brownish semi-transparent particles, irregular in shape, with adhering smoke particles. He concluded that the substance was not silicious and was probably of local origin as the particles were rather large to travel any distance. They did not, however, appear to be ash or dust from chimneys.

In a later letter Mr. Baxendell furnished the following information :

" After writing to Mr. Bilham with the samples of the deposit, my deputy observer chanced to meet me, and on my mentioning the deposit to him, he at once explained that he had examined some under the microscope, immediately after it fell, and that he found it to consist of algae (class *Isokontae*, species: *Trentepohlia;* I understood him to say). My deputy observer (Mr. A. R. Yarwood), is a very keen and well-equipped microbiologist, and his conclusions are generally fully reliable. He added that these algae could not be recognised when dry. They are common epiphytes on leaves in tropical countries, but in England are only found on the windward sides of rocks, in mountain districts, where they prefer, particularly, carboniferous limestone and silurian Rocks. He has definitely found them in the Peak district of Derbyshire, and it is noteworthy that the direction of the wind at the time of the shower was from that very point. On their way here, they evidently encountered soot, particles of which adhered, as you found, to several of them. It is, of course, well known that such algae are propagated by means of spores, which are dispersed by the wind, and which, on gathering moisture, assume the vegetative state, as filaments—this particular kind being of an orange colour, or rather, perhaps, yellowish-brown. The Southport deposit was remarkably thick, and extended densely over at least 10 square miles, and thinly over many more. It happens that Mr. Yarwood witnessed a similar but redder fall in Norfolk in 1917, which proved to be another member of the same family."

It may be remarked that the general wind direction during the night in question was from S. to SW., and it seems more likely therefore that the algae were derived from the mountains of Wales than from those of Derbyshire. In any case the occurrence furnishes an interesting addition to the already long list of air-borne vegetable, animal and mineral substances, numerous references to which are to be found in meteorological literature.

Reviews

India Meteorological Department. *Scientific Notes.* Vol. I, Nos. 4-6, pp. 37-67. Prices 10d., 8d., 9d.

The first paper " On temperatures of exposed rails at Agra," by K. R. Ramanathan, M.A., D.Sc., contains results of great importance to the engineer who has to allow for the expansion of the ironwork of bridges, &c. As a comparison is made with the temperatures in a Stevenson screen and with a grass minimum thermometer it is possible to apply the results to other localities having similar conditions as regards radiation. In any case the method of carrying out the tests over nearly a year will serve as a model to anyone who has to make similar investigations in another country.

The second paper is on the "Frequency of Thunderstorms in India." In connexion with the sending of airships to India a knowledge of thunderstorm frequency is important. The records of the past 10 years were therefore examined, but in a number of cases it was found that these were unreliable, the number of storms recorded being clearly too few. The southern areas such as Ceylon and Madras get most storms, Cochin, for instance, gets 101 per year and Lower Burmah as many as 154. There are two maxima in the south, in April and October or November; as we move northward the months of maxima generally approach each other.

In the third paper Rao Saheb M. V. Unakar, B.A., deals with "Correlations between pre-monsoon conditions over northwest India and subsequent monsoon rainfall over northwest India and the Peninsula." The formula at present in use for foreshadowing the monsoon in northwest India contains as one of the factors the snow accumulation on the Himalayas in May. As, however, the numerical estimate of snow is rough and uncertain, Mr. Unakar has worked with rainfall in the Himalayas and in northwest India in March and the discharge of the Ganges in May. A considerable improvement follows and instead of a correlation of $-0{\cdot}40$ which is the relationship between the monsoon of northwest India June to September and the snowfall accumulation in May he gets a total correlation of 0·59 with the three factors, snow, rain and river. The writer then makes a further examination of the months of July and August, which are the mid-monsoon months, and for the monsoon of these two months the total coefficient with preceding snow, rain and river is as big as 0·66. The practical application of these results, however, to the improvement of the existing formula for foreshadowing the monsoon still remains to be done. This memoir contains tables of data which should be very useful to other workers.

E. W. Bliss.

Deutsches Meteorologisches Jahrbuch für 1927. *Freistaat Sachsen.* Edited by Direktor Prof. Dr. E. Alt. Jahrgang 45, Dresden, 1929.

This quarto volume of nearly 200 pages of text and more than 50 pages of charts presents the meteorological statistics of Saxony for a single year, with a notable abundance of detail. Full daily observations at three separate hours are given at Wahnsdorf and the high-level station of Fichtelberg, daily rainfalls for about 500 stations and a general summary of the weather of each month. Subsequent sections of the year book give monthly and annual climatological summaries for 32 stations, frequencies of various phenomena, phenological observations and hourly means for each month, while the monthly distribution of all elements is shown in a series of charts. The two appendices give results of registering balloon ascents at Leipzig and Dresden and a dissertation by Dr. E. Göhlert on the rate of physiological cooling in Germany on the basis of a formula devised by Dr. Leonard Hill.

Obituary

We regret to learn of the death on May 27th, 1930, at the age of 73, of Father José Algué, S.J., Director of the Philippine Weather Bureau, Manila, from 1897 to 1924.

We regret to learn of the death, on May 11th, 1930, at the age of 50, of Dr. Wilh. R. Eckardt, Director of the Meteorological Observatory and Weather Service at Essen.

We also regret to learn of the death on April 5th, 1930, at Hamburg, at the age of 66, of Kommodore Hans Ruser, Captain of the *Gauss* on the German South Polar expedition of 1901-3.

News in Brief

Colonel Sir Henry G. Lyons has been reappointed Director and Secretary of the Science Museum, and will hold that Office until October, 1933.

Dr. O. Hoelper has succeeded the late Prof. Dr. P. Polis as Director of the Meteorological Observatory at Aachen.

Erratum

May, 1930, page 98, line 22 *for* " cutting " *read* " culling."

The Weather of June, 1930

Sunny weather prevailed generally over the whole country during the month. In the south and east it was also dry and warm, but in the north and west it was unsettled, the total rainfall being above the normal and temperature slightly below normal. Thundery conditions were experienced frequently. Slight rain occurred in many parts of England on the 1st and 2nd, with a heavy rainstorm in central London on the 2nd, but anticyclonic weather spread across the whole country on the 3rd and temperature rose gradually until the 6th, when 80° F. and above was experienced inland, 82° F. at Cullompton and 81° F. at Sheffield. On the 7th the winds became northerly with a subsequent drop in temperature, but the weather continued sunny, the 6th, 7th, and 8th being the three sunniest days at the beginning of the month; Aberdeen had 15·8hrs. on the 7th, Gorleston 15·5hrs. on the 6th. There followed a period of cloudy weather as a depression over Iceland moved eastwards. Rainfall was generally slight except in Scotland, north England and Wales on the 9th when 2·56 in. fell at Oakeley (Merioneth) and 1·70 in. at Rosthwaite (Cumberland). On the 10th and 11th fair weather returned to Scotland, 16·1hrs. bright sunshine were recorded at Aberdeen on the 11th, but this did not extend to England until the 12th, when the high pressure area over central Europe began to move north and west. From the 12th to 19th local thunderstorms were almost of daily occurrence,* but apart from these the weather was generally fair and sunny. Temperature was high generally during this period, reaching 83° F. at Greenwich and 80° F. at Cambridge and Norwich on the 18th and 79° F. at Fort Augustus on the 16th. From the 20th to the end of the month westerly winds prevailed with fair sunny weather generally in the south, but rain at times with sunny intervals in the north and west. Temperature was slightly lower than during the previous days, but again exceeded 80° F. locally on the 30th. Thunderstorms were experienced generally between the 22nd and 24th. Ground frosts occurred on one or two nights at a few places during the month, the ground minimum temperature falling as low as 25° F. at Rhayader on the 27th. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs).
Stornoway	231	+53	Liverpool	214	+14
Aberdeen	244	+60	Ross-on-Wye	236	+39
Dublin	251	+62	Falmouth	219	— 2
Birr Castle	217	+53	Gorleston	243	+33
Valentia	225	+37	Kew	227	+30

Pressure was above normal over Scandinavia, Holland, Germany, and in a belt across the North Atlantic from south Spain to Bermuda and Newfoundland, the greatest excess being 3·3 mb. at Skagen and Bornholm, while pressure was below normal over Spitsbergen, Iceland, the British Isles, France, Switzerland, and Italy, the greatest deficit being 8·5 mb. at Reykjavik. Temperature was generally above normal except in Portugal and rainfall deficient except in Scotland, Spitsbergen, and locally in Sweden. In Gothaland and part of Norrland, however, it was only 50 per cent. of the normal.

A severe storm in the Seine and Oise department, France, did considerable damage to the village of Chevreuse on the 2nd,

---

See p. 129.

and some loss of life and much damage to crops was caused by the torrential rains experienced in Castile and Andalusia during the first days of the month. A violent thunderstorm swept over Canton Berne, on the 7th, causing a landslide and damage to crops, and several villages in the Bernese Oberland were flooded on the 8th after a thunderstorm accompanied by hail. A hailstorm on the 11th devastated vineyards near Geneva. Heavy thunderstorms were also experienced in northern France and Switzerland on the 12th and 14th with resulting floods. The Saint Barthelemy torrent again overflowed in the Rhône Valley near St. Maurice on the 23rd owing to heavy rains. Cold weather with heavy rain and snow occurred in Iceland about the 27th. Abnormal heat and drought were experienced in Hungary during the month.

The intense heat recorded in Egypt resulted in the deaths of two women on the 11th.

The monsoon was active in Burma and Assam during the week ended the 11th, and had advanced along the west coast of India to Bombay by the 9th. A train from Ahmedabad was struck by a cyclonic storm near Himmatnagar on the 10th, and many of the coaches were blown off the track and overturned. One passenger was killed.

Rain fell generally throughout New South Wales on the 1st and 2nd, and again about the middle of the month, as much as 14in. being reported to have fallen in two days in the north-eastern area.

Much needed rain fell in all districts of the Prairie provinces during the week ended the 24th, but in Ontario three trains were wrecked about the 26th owing to floods caused by heavy rains. In the United States temperature was high for the time of year in the Lake region, Mountain region and along the Pacific coast, and low elsewhere during the first part of the month. Later it was high over most of the country. Rainfall was deficient in the west and in excess in the northeast. In Argentina temperature was mainly above normal and rainfall in excess at first but later deficient.

The special message from Brazil states that the rainfall in the northern regions was irregular in distribution with 0·59in. above normal and scarce in the central and southern regions with 0·43in. and 1·10in. below normal respectively. Only four anticyclones passed across the country. The crops, however, were generally in good condition despite the abnormal conditions. At Rio de Janeiro pressure was 1·4mb. below normal and temperature 3·6°F. above normal.

Rainfall, June, 1930.—General Distribution

England and Wales	59	per cent of the average 1881-1915.
Scotland	109	
Ireland	88	
British Isles	78	

Rainfall: June, 1930: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square.........	3·18	157	*Leics* .	Belvoir Castle...........	·75	39
Sur .	Reigate, Alvington.....	·48	23	*Rut* :	Ridlington...............	1·00	...
Kent .	Tenterden, Ashenden...	1·05	55	*Linc* .	Boston, Skirbeck........	1·09	60
,, .	Folkestone, Boro. San..	·86	...	,, .	Cranwell Aerodrome...	·91	54
,, .	Margate, Cliftonville...	1·04	59	,, .	Skegness, Marine Gdns	1·65	92
,, .	Sevenoaks, Speldhurst	·70	...	,, .	Louth, Westgate........	1·95	90
Sus .	Patching Farm.........	1·14	56	,, .	Brigg, Wrawby St.....	2·60	...
,, .	Brighton, Old Steyne..	·69	38	*Notts* .	Worksop, Hodsock.....	2·48	124
,,	Heathfield, Barklye....	1·07	51	*Derby* .	Derby, L. M. & S. Rly.	1·76	78
Hants .	Ventnor, Roy. Nat. Hos.	·69	38	,, .	Buxton, Devon Hos....	2·59	80
,, .	Fordingbridge, Oaklnds	·47	25	*Ches* .	Runcorn, Weston Pt...	1·08	42
,, .	Ovington Rectory.......	·36	16	,, .	Nantwich, Dorfold Hall	·70	...
,, .	Sherborne St. John.....	·60	28	*Lancs* .	Manchester, Whit. Pk.	2·48	94
Berks .	Wellington College.....	·28	13	,, .	Stonyhurst College.....	3·15	103
,, .	Newbury, Greenham...	·56	26	,, .	Southport, Hesketh Pk	1·40	64
Herts .	Welwyn Garden City...	·49	...	,, .	Lancaster, Strathspey	2·14	...
Bucks .	High Wycombe..........	·46	24	*Yorks* .	Wath-upon-Dearne.....	·64	29
Oxf . .	Oxford, Mag. College..	·86	40	,, .	Bradford, Lister Pk....	2·57	109
Nor .	Pitsford, Sedgebrook...	1·16	60	,, .	Oughtershaw Hall......	2·69	...
,, .	Oundle....................	·23	...	,, .	Wetherby, Ribston H.	2·06	98
Beds .	Woburn, Crawley Mill	·45	23	,, .	Hull, Pearson Park.....	1·46	71
Cam .	Cambridge, Bot. Gdns.	...	...	,, .	Holme-on-Spalding.....	1·47	...
Essex .	Chelmsford, CountyLab	·53	28	,, .	West Witton, Ivy Ho.	1·23	...
,, .	Lexden Hill House....	·41	...	,, .	Felixkirk, Mt. St. John	2·05	94
Suff .	Hawkedon Rectory.....	·81	39	,, .	Pickering, Hungate....	1·78	...
,, .	Haughley House........	·48	...	,, .	Scarborough.............	1·59	86
Norf .	Norwich, Eaton...	·89	46	,, .	Middlesbrough..........	1·16	61
,, .	Wells, Holkham Hall	...	...	,, .	Baldersdale, Hury Res.	1·86	...
,, .	Little Dunham..........	1·26	56	*Durh* .	Ushaw College...........	1·15	53
Wilts .	Devizes, Highclere......	1·99	88	*Nor* .	Newcastle, Town Moor	·60	28
,, .	Bishops Cannings.......	2·06	85	,, .	Bellingham, Highgreen	1·28	...
Dor .	Evershot, Melbury Ho.	·62	27	,, .	Lilburn Tower Gdns....	·95	...
,, .	Creech Grange..........	·56	...	*Cumb* .	Geltsdale.................	2·27	...
,, .	Shaftesbury, Abbey Ho.	1·09	47	,, .	Carlisle, Scaleby Hall	2·79	111
Devon .	Plymouth, The Hoe....	·65	30	,, .	Borrowdale, Seathwaite	5·20	80
,, .	Polapit Tamar...........	·81	38	,, .	Borrowdale, Rosthwaite	4·28	...
,, .	Ashburton, Druid Ho.	...	...	,, .	Keswick, High Hill.....	2·82	...
,, .	Cullompton.......	·50	24	*Glam* .	Cardiff, Ely P. Stn.....	·73	29
,, .	Sidmouth, Sidmount...	·28	13	,, .	Treherbert. Tynywaun	4·24	...
,, .	Filleigh, Castle Hill....	·77	...	*Carm* .	Carmarthen Friary.....	2·46	86
,, .	Barnstaple. N. Dev. Ath.	·59	26	,, .	Llanwrda.................	2·84	84
Corn .	Redruth, Trewirgie.....	1·81	73	*Pemb* .	Haverfordwest, School	2·35	87
,, .	Penzance, Morrab Gdn.	1·39	63	*Card* .	Aberystwyth............	2·36	...
,, .	St. Austell, Trevarna...	·91	35	,, .	Cardigan, County Sch.	1·29	...
Soms .	Chewton Mendip........	·62	32	*Brec* .	Crickhowell, Talymaes	1·20	...
,, .	Long Ashton.............	1·98	...	*Rad* .	Birm W. W. Tyrmynydd	1·87	57
,, .	Street, Millfield	1·00	...	*Mont* .	Lake Vyrnwy...........	2·89	91
Glos. .	Cirencester, Gwynfa....	2·21	92	*Denb* .	Llangynhafal............	·77	...
Here .	Ross, Birchlea...........	·65	30	*Mer* .	Dolgelly, Bryntirion...	2·99	86
,, .	Ledbury, Underdown..	1·70	75	*Carn* .	Llandudno...............	1·21	60
Salop .	Church Stretton.........	·96	40	,, .	Snowdon, L. Llydaw 9	8·25	...
,, .	Shifnal, Hatton Grange	·82	37	*Ang* .	Holyhead, Salt Island	1·56	72
Worc .	Ombersley, Holt Lock	1·19	53	,, .	Lligwy....................	1·46	...
,, .	Blockley..................	2·58	..	*Isle of Man*			
War .	Farnborough.............	1·95	82		Douglas, Boro' Cem....	2·23	92
,, .	Birminghm, Edgbaston	1·35	58	*Guernsey*			
Leics .	Thornton Reservoir....	1·82	84		St. PeterP't. GrangeRd.	1·10	59

Rainfall : June, 1930 : Scotland and Ireland

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Wigt.	Pt. William, Monreith	2·16	...	*Suth* .	Loch More, Achfary...	5·25	142
,, .	New Luce School......	...	...	*Caith* .	Wick......................	3·19	177
Kirk .	Carsphairn, Shiel.......	3·92	...	*Ork* .	Pomona, Deerness......	1·93	106
,, .	Dumfries, Cargen......	...	...	*Shet* .	Lerwick..................	2·98	167
Dumf.	Eskdalemuir Obs.......	4·18	133	*Cork* .	Caheragh Rectory......	3·33	...
Roxb .	Branxholm..............	2·15	96	,, .	Dunmanway Rectory...	3·40	97
Selk .	Ettrick Manse..........	3·45	...	,, .	Ballinacurra.............	1·91	73
Peeb .	West Linton...........	2·61	...	,, .	Glanmire, Lota Lo......	2·55	94
Berk .	Marchmont House......	1·64	71	*Kerry*.	Valentia Obsy..........	3·65	114
Hadd.	North Berwick Res.....	1·60	96	,, .	Gearahameen............	4·60	...
Midl .	Edinburgh, Roy. Obs.	1·81	98	,, .	Killarney Asylum......	2·88	99
Ayr .	Kilmarnock, Agric. C.	3·04	138	,, .	Darrynane Abbey.......	2·81	89
,, .	Girvan, Pinmore..	2·33	81	*Wat* .	Waterford, Brook Lo...	2·59	96
Renf .	Glasgow, Queen's Pk. .	3·22	139	*Tip* .	Nenagh, Cas. Lough...	2·11	86
,, .	Greenock, Prospect H.	3·70	102	,, .	Roscrea, Timoney Park	2·81	...
Bute .	Rothesay, Ardencraig.	3·34	114	,, .	Cashel, Ballinamona...	2·63	114
,, .	Dougarie Lodge.........	2·77	...	*Lim* .	Foynes, Coolnanes......	2·29	89
Arg .	Ardgour House.........	6·97	...	,, .	Castleconnel Rec.......	2·16	...
,, .	Manse of Glenorchy...	4·32	...	*Clare* .	Inagh, Mount Callan...	4·05	...
,, .	Oban......................	3·26	...	,, .	Broadford, Hurdlest'n.	2·84	...
,, .	Poltalloch...............	3·46	113	*Wexf*.	Newtownbarry	...	...
,, .	Inveraray Castle...	4·81	122	,, .	Gorey, Courtown Ho...	1·46	60
,, .	Islay, Eallabus.........	4·26	163	*Kilk* .	Kilkenny Castle.........	2·59	107
,, .	Mull, Benmore.........	8·60	...	*Wic* .	Rathnew, Clonmannon	1·91	...
,, .	Tiree	4.08	...	*Carl* .	Hacketstown Rectory..	2·10	75
Kinr .	Loch Leven Sluice......	2·39	109	*Leix* .	Blandsfort House......	3·08	119
Perth .	Loch Dhu...............	4·30	103	,, .	Mountmellick...........	2·63	...
,, .	Balquhidder, Stronvar	2·33	...	*Off'ly* .	Birr Castle..............	...	...
,, .	Crieff, Strathearn Hyd.	2·02	76	*Dubl* .	Dublin, FitzWm. Sq...	1·68	86
,, .	Blair Castle Gardens...	2·43	123	,, .	Balbriggan, Ardgillan.	1·49	74
,, .	Glen Bruar, Bruar Ldg.	2·59	...	*Me'th* .	Beauparc, St. Cloud...	2·14	...
Angus.	Kettins School.	1·92	103	,, .	Kells, Headfort.........	2·48	93
,, .	Dundee, E. Necropolis	1·89	105	*W.M* .	Moate, Coolatore......	1·58	...
,, .	Pearsie House...........	2·38	...	,, .	Mullingar, Belvedere..	1·63	63
,, .	Montrose, Sunnyside...	...	...	*Long* .	Castle Forbes Gdns......	1·65	64
Aber .	Braemar, Bank...	1·56	80	*Gal* .	Ballynahinch Castle...	4·26	120
,, .	Logie Coldstone Sch....	1·82	93	,, .	Galway, Grammar Sch.	2·58	...
,, .	Aberdeen, King's Coll.	2·21	129	*Mayo* .	Mallaranny..............	...	...
,, .	Fyvie Castle.............	3·04	...	,, .	Westport House.........	2·16	80
Moray.	Gordon Castle...........	1·13	55	,, .	Delphi Lodge...........	6·03	...
,, .	Grantown-on-Spey......	1·58	70	*Sligo* .	Markree Obsy............	2·92	97
Nairn.	Nairn, Delnies	1·15	65	*Cav'n* .	Belturbet, Cloverhill...	2·16	88
Inv .	Kingussie, The Birches	1·51	...	*Ferm* .	Enniskillen, Portora...	2·75	...
,, .	Loch Quoich, Loan.....	7·89	...	*Arm* .	Armagh Obsy...........	1·50	60
,, .	Glenquoich.............	6·17	126	*Down* .	Fofanny Reservoir......	3·64	...
,, .	Inverness, Culduthel R.	1·10	...	,, .	Seaforde..................	1·84	67
,, .	Arisaig, Faire-na-Squir	3·81	...	,, .	Donaghadee, C. Stn...	2·15	92
,, .	Fort William...........	5·99	...	,, .	Banbridge, Milltown...	2·13	...
,, .	Skye, Dunvegan........	5·36	...	*Antr* .	Belfast, Cavehill Rd...	2·30	...
R & C.	Alness, Ardross Cas ...	1·93	85	,, .	Glenarm Castle.........	3·21	...
,, .	Ullapool.................	3·04	...	,, .	Ballymena, Harryville	2·42	83
,, .	Torridon, Bendamph...	4·26	104	*Lon* .	Londonderry, Creggan	3·13	111
,, .	Achnashellach..........	5·54	...	*Tyr* .	Donaghmore............	2·20	...
,, .	Stornoway..............	2·60	112	,, .	Omagh, Edenfel.........	2·04	72
Suth .	Lairg.....................	2·07	...	*Don* .	Malin Head..............	2·87	...
,, .	Tongue..................	2·33	114	,, .	Dunfanaghy..............	2·62	...
,, .	Melvich..................	2.50	...	,, .	Killybegs, Rockmount.	3·15	83

Climatological Table for the British Empire, January, 1930.

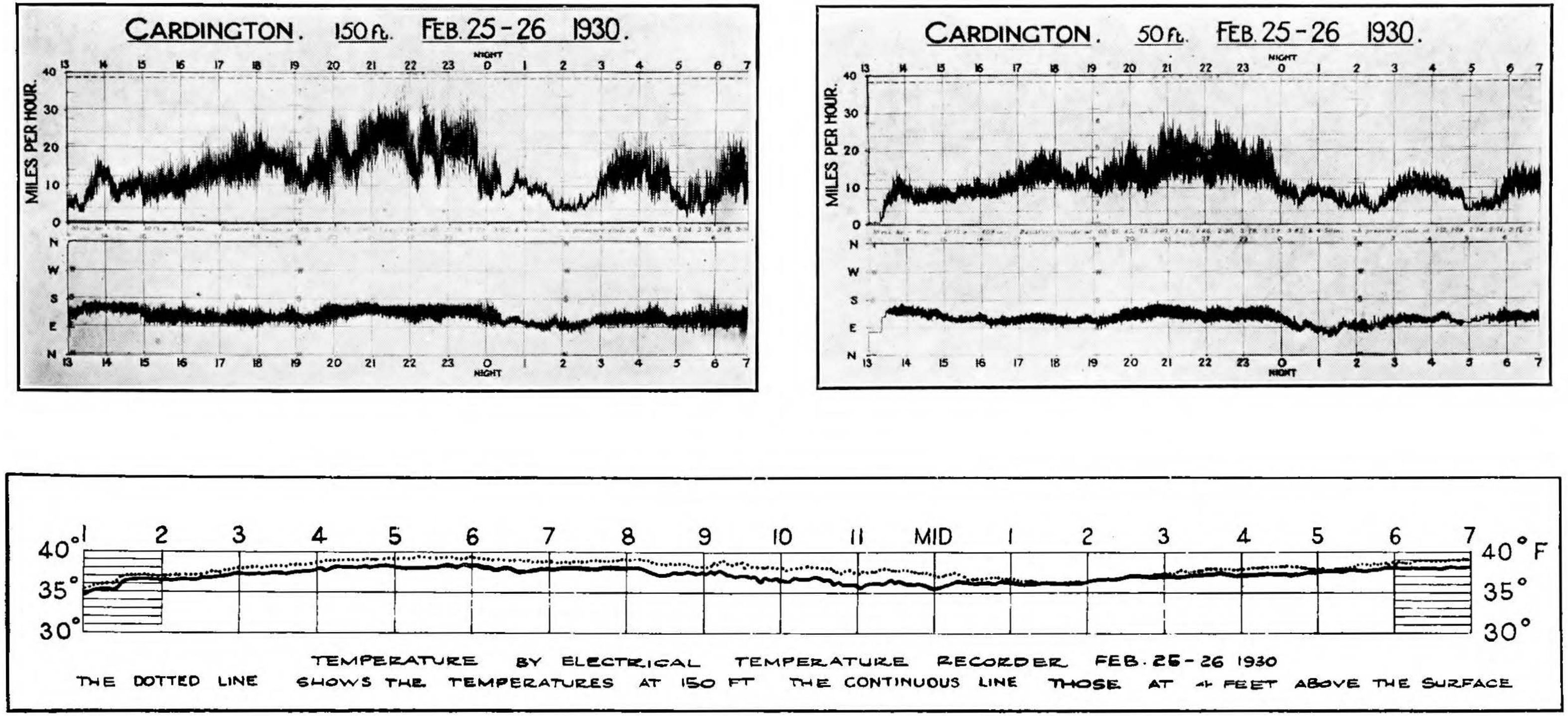
STATIONS	PRESSURE		TEMPERATURE							Rela-tive Humi-dity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L. mb.	Diff. from Normal mb.	Absolute Max. ° F.	Absolute Min. ° F.	Mean Values Max. ° F.	Mean Values Min. ° F.	Mean Values ½ max. and min. ° F.	Mean Values Diff. from Normal ° F.	Mean Wet Bulb ° F.	%	0—10	Am'nt in.	Diff. from Normal in.	Days	Hours per day	Per-cent-age of possi-ble
London, Kew Obsy.	1008·4	— 9·2	56	28	48·7	38·8	43·7	+ 4·8	41·0	90	7·5	2·71	+ 0·95	21	1·4	16
Gibraltar	1019·1	— 2·1	67	43	60·1	50·1	55·1	+ 0·3	50·4	83	6·6	5·00	— 0·06	18	..	..
Malta	1018·2	+ 0·6	63	46	58·8	51·5	55·1	— 0·2	51·0	78	6·4	4·72	+ 1·51	20	4·8	48
St. Helena	1012·3	+ 2·3	..	57	..	58·5	..	..	59·5	94	8·9	1·85	— 1·12	16	..	..
Sierra Leone	1012·7	+ 1·9	90	72	86·2	73·7	79·9	— 1·4	74·8	80	4·0	0·00	— 0·41	0	..	..
Lagos, Nigeria	1008·9	— 1·0	·89	69	86·5	73·9	80·2	— 0·7	75·0	88	5·5	1·38	+ 0·31	5	..	..
Kaduna, Nigeria	1016·2	+ 4·6	94	..	87·5	..	..	..	67·1	84	1·0	0·00	0·00	0	..	..
Zomba, Nyasaland	1008·2	+ 0·8	85	61	79·0	65·0	72·0	— 0·8	..	79	8·0	9·88	— 1·22	19	..	..
Salisbury, Rhodesia	1007·9	0·0	85	53	78·0	59·3	68·7	— 1·0	61·8	65	6·4	3·90	— 3·57	19	6·8	52
Cape Town	1014·6	+ 1·2	94	53	79·2	61·1	70·1	+ 0·2	61·6	68	2·0	0·76	+ 0·08	4	..	..
Johannesburg	1012·7	+ 1·4	83	47	76·0	55·4	65·7	— 0·8	57·7	73	4·8	4·89	— 1·28	18	7·7	57
Mauritius	1010·3	— 1·6	88	69	82·9	73·2	78·1	— 1·2	74·3	75	7·2	9·06	+ 1·30	26	7·5	57
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	2·32	— 1·70	..	..	..
Calcutta, Alipore Obsy.	1014·8	— 0·4	86	49	77·2	55·0	66·1	— 0·3	55·8	86	2·1	0·00	— 0·34	0*	..	..
Bombay	1012·8	— 0·8	91	60	82·9	66·0	74·5	— 0·8	63·9	71	1·8	0·00	— 0·10	0*	..	..
Madras	1013·5	— 0·6	86	63	83·3	68·4	75·9	— 0·2	71·1	87	4·6	1·47	+ 0·08	2*	..	..
Colombo, Ceylon	1011·4	— 0·1	90	69	86·5	71·6	79·1	0·0	73·8	74	4·7	5·75	+ 2·25	11	8·3	70
Hongkong	1020·4	+ 0·6	72	41	59·1	50·9	55·0	— 5·2	50·7	76	8·8	2·27	+ 0·90	9	2·3	21
Sandakan	..	..	88	70	85·1	73·2	79·1	— 0·7	75·4	81	..	18·56	+ 0·11	14	..	..
Sydney, N.S.W.	1013·6	+ 1·1	100	59	75·7	64·2	69·9	— 1·8	64·6	65	5·9	4·58	+ 0.85	13	8·0	57
Melbourne	1014·8	+ 1·9	103	47	78·2	55·3	66·7	— 0·8	57·8	55	3·3	0·14	— 1·71	4	8·4	58
Adelaide	1015·1	+ 2·1	108	50	84·5	60·0	72·3	— 1·6	59·2	35	1·5	0·02	— 0·71	1	12·5	89
Perth, W. Australia	1013·5	+ 1·0	108	54	85·9	62·9	74·4	+ 0·5	62·2	45	1·2	0·05	— 0·29	2	12·1	87
Coolgardie	1011·8	+ 0·4	115	51	96·6	61·7	79·1	+ 1·7	61·2	34	0·5	0·00	— 0·47	0	..	..
Brisbane	1011·9	+ 0·6	95	64	82·8	69·2	76·0	— 1·2	70·5	71	8·1	9·94	+ 3·67	23	4·9	36
Hobart, Tasmania	1011·1	+ 0·8	93	41	69·2	50·5	59·9	— 2·4	52·7	55	6·2	0·98	— 0·81	10	9·2	62
Wellington, N.Z.	1008·8	— 4·5	70	44	64·4	54·1	59·3	— 3·2	55·9	79	7·5	5·44	+ 2·11	19	6·3	43
Suva, Fiji	1007·2	— 0·5	92	70	86·9	75·4	81·1	+ 1·2	77·2	79	6·4	17·31	+ 6·59	25	6·9	53
Apia, Samoa	1007·2	— 0·7	88	74	86·0	76·5	81·2	+ 2·2	78·6	79	5·0	10·17	— 66·4	22	6·2	48
Kingston, Jamaica	1015·6	+ 0·5	87	64	84·3	67·3	75·8	— 1·0	65·5	84	2·6	0·90	— 0·06	5	8·2	73
Grenada, W.I.	1009·1	— 3·5	89	71	85·2	72·2	78·7	+ 1·7	73·5	77	4·7	4·98	+ 0·55	19	..	..
Toronto	1022·3	+ 4·9	47	— 4	28·9	16·7	22·8	+ 0·7	19·2	68	8·2	3·33	+ 0·46	19	2·7	29
Winnipeg	1025·0	+ 5·2	23	—35	0·0	-14·7	— 7·3	— 2·9	..	..	5·1	0·29	— 0·53	9	3·2	37
St. John, N.B.	1022·5	+ 6·8	48	— 4	28·4	11·5	19·9	+ 0·7	16·5	66	6·0	3·51	— 1·29	15	3·5	38
Victoria, B.C.	1019·4	+ 4·1	47	15	36·0	28·1	32·1	— 8·0	28·2	70	4·5	1·10	— 3·41	11	4·5	51

Climatological Table for the British Empire, January, 1930.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean			Am'nt	Diff. from Normal	Days	Hours per day	Per-cent-age of possi-ble
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb							
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1008·4	— 9·2	56	28	48·7	38·8	43·7	+ 4·8	41·0	90	7·5	2·71	+ 0·95	21	1·4	16
Gibraltar	1019·1	— 2·1	67	43	60·1	50·1	55·1	+ 0·3	50·4	83	6·6	5·00	— 0·06	18	..	..
Malta	1018·2	+ 0·6	63	46	58·8	51·5	55·1	— 0·2	51·0	78	6·4	4·72	+ 1·51	20	4·8	48
St. Helena	1012·3	+ 2·3	..	57	..	58·5	..	..	59·5	94	8·9	1·85	— 1·12	16	..	..
Sierra Leone	1012·7	+ 1·9	90	72	86·2	73·7	79·9	— 1·4	74·8	80	4·0	0·00	— 0·41	0	..	..
Lagos, Nigeria	1008·9	— 1·0	89	69	86·5	73·9	80·2	— 0·7	75·0	88	5·5	1·38	+ 0·31	5	..	..
Kaduna, Nigeria	1016·2	+ 4·6	94	..	87·5	..	..	..	67·1	84	1·0	0·00	0·00	0	..	..
Zomba, Nyasaland	1008·2	+ 0·8	85	61	79·0	65·0	72·0	— 0·8	..	79	8·0	9·88	— 1·22	19	..	..
Salisbury, Rhodesia	1007·9	0·0	85	53	78·0	59·3	68·7	— 1·0	61·8	65	6·4	3·90	— 3·57	19	6·8	52
Cape Town	1014·6	+ 1·2	94	53	79·2	61·1	70·1	+ 0·2	61·6	68	2·0	0·76	+ 0·08	4	..	..
Johannesburg	1012·7	+ 1·4	83	47	76·0	55·4	65·7	— 0·8	57·7	73	4·8	4·89	— 1·28	18	7·7	57
Mauritius	1010·3	— 1·6	88	69	82·9	73·2	78·1	— 1·2	74·3	75	7·2	9·06	+ 1·30	26	7·5	57
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	2·32	— 1·70	..	..	..
Calcutta, Alipore Obsy.	1014·8	— 0·4	86	49	77·2	55·0	66·1	— 0·3	55·8	86	2·1	0·00	— 0·34	0*	..	..
Bombay	1012·8	— 0·8	91	60	82·9	66·0	74·5	— 0·8	63·9	71	1·8	0·00	— 0·10	0*	..	..
Madras	1013·5	— 0·6	86	63	83·3	68·4	75·9	— 0·2	71·1	87	4·6	1·47	+ 0·08	2*	..	..
Colombo, Ceylon	1011·4	— 0·1	90	69	86·5	71·6	79·1	0·0	73·8	74	4·7	5·75	+ 2·25	11	8·3	70
Hongkong	1020·4	+ 0·6	72	41	59·1	50·9	55·0	— 5·2	50·7	76	8·8	2·27	+ 0·90	9	2·3	21
Sandakan	..	..	88	70	85·1	73·2	79·1	— 0·7	75·4	81	..	18·56	+ 0·11	14	..	..
Sydney, N.S.W.	1013·6	+ 1·1	100	59	75·7	64·2	69·9	— 1·8	64·6	65	5·9	4·58	+ 0·85	13	8·0	57
Melbourne	1014·8	+ 1·9	103	47	78·2	55·3	66·7	— 0·8	57·8	55	3·3	0·14	— 1·71	4	8·4	58
Adelaide	1015·1	+ 2·1	108	50	84·5	60·0	72·3	— 1·6	59·2	35	1·5	0·02	— 0·71	1	12·5	89
Perth, W. Australia	1013·5	+ 1·0	108	54	85·9	62·9	74·4	+ 0·5	62·2	45	1·2	0·05	— 0·29	2	12·1	87
Coolgardie	1011·8	+ 0·4	115	51	96·6	61·7	79·1	+ 1·7	61·2	34	0·5	0·00	— 0·47	0	..	..
Brisbane	1011·9	+ 0·6	95	64	82·8	69·2	76·0	— 1·2	70·5	71	8·1	9·94	+ 3·67	23	4·9	36
Hobart, Tasmania	1011·1	+ 0·8	93	41	69·2	50·5	59·9	— 2·4	52·7	55	6·2	0·98	— 0·81	10	9·2	62
Wellington, N.Z.	1008·8	— 4·5	70	44	64·4	54·1	59·3	— 3·2	55·9	79	7·5	5·44	+ 2·11	19	6·3	43
Suva, Fiji	1007·2	— 0·5	92	70	86·9	75·4	81·1	+ 1·2	77·2	79	6·4	17·31	+ 6·59	25	6·9	53
Apia, Samoa	1007·2	— 0·7	88	74	86·0	76·5	81·2	+ 2·2	78·6	79	5·0	10·17	— 66·4	22	6·2	48
Kingston, Jamaica	1015·6	+ 0·5	87	64	84·3	67·3	75·8	— 1·0	65·5	84	2·6	0·90	— 0·06	5	8·2	73
Grenada, W.I.	1009·1	— 3·5	89	71	85·2	72·2	78·7	+ 1·7	73·5	77	4·7	4·98	+ 0·55	19	..	..
Toronto	1022·3	+ 4·9	47	— 4	28·9	16·7	22·8	+ 0·7	19·2	68	8·2	3·33	+ 0·46	19	2·7	29
Winnipeg	1025·0	+ 5·2	23	—35	0·0	-14·7	— 7·3	— 2·9	..	..	5·1	0·29	— 0·53	9	3·2	37
St. John, N.B.	1022·5	+ 6·8	48	— 4	28·4	11·5	19·9	+ 0·7	16·5	66	6·0	3·51	— 1·29	15	3·5	38
Victoria, B.C.	1019·4	+ 4·1	47	15	36·0	28·1	32·1	— 8·0	28·2	70	4·5	1·10	— 3·41	11	4·5	51

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

facing p. 153.



CARDINGTON. 150 ft. FEB. 25-26 1930.

CARDINGTON. 50 ft. FEB. 25-26 1930.

TEMPERATURE BY ELECTRICAL TEMPERATURE RECORDER FEB. 25-26 1930

THE DOTTED LINE SHOWS THE TEMPERATURES AT 150 FT THE CONTINUOUS LINE THOSE AT 4 FEET ABOVE THE SURFACE

AUTOGRAPHIC RECORDS OF WIND AND TEMPERATURE AT CARDINGTON, FEB. 25TH-26TH, 1930 (*see p.* 153).

M.O. 326.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 65

Aug., 1930

No. 775

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:
ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH;
YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 15, DONEGALL
SQUARE WEST, BELFAST; or through any Bookseller.

Unusual Gustiness at Cardington on the night of February 25th-26th, 1930.

By C. S. DURST, B.A.

The records obtained at Cardington with a Dines pressure-tube anemometer, the head being 150 feet above ground level, put in evidence very strikingly the different types of turbulence which are found associated with various thermal structures of the lower layers of the atmosphere. In general, super-adiabatic or adiabatic temperature gradients in the first 150 feet above the surface are associated with a large range of oscillations (both in direction and velocity) of the wind, while with an inversion the range of oscillations is small, indeed in some cases a wind of as much as eleven or twelve miles per hour has been recorded at 150 feet with no fluctuations at all.

The synoptic charts for 13h. G.M.T. on February 25th, 1930, showed that a southerly current of air with high temperature was moving over France with considerable quantities of stratocumulus cloud. The vertical temperature gradient at Cardington on that day showed an inversion even during the early afternoon owing to the warmer air moving over ground that had previously been cooled by a prevalence of easterly winds

There was, therefore, expectation that similar temperature conditions would continue throughout the night, and that turbulence would be damped by the inversion. However, between 15h. G.M.T. and midnight the turbulence was abnormally large even though the temperature gradient still showed an inversion. This was thrown into even greater prominence by the events after midnight. Between that hour and 1h. G.M.T. the inversion

(90631) P.S.14/89 1,050 8/30 M. & S. *Gp.303*

decreased, and between 1h. 30m. and 3h. G.M.T. conditions between 150 feet and the surface were isothermal. The wind, however, showed a very marked decrease of turbulence during this period, but at 3h. the turbulence again increased when an inversion formed once again.

The association between temperature gradient and turbulence was thus exactly reversed from the normal on this occasion. There does not appear to be any very obvious explanation of this reversal from the normal, but certain facts may be noted which will probably enter into such an explanation.

In the first case, this inversion was not due to radiation but to differences in temperature between earth and air. It is, therefore, to be expected that there should be an association between higher wind speed and bigger inversion values. At the same time, the air being highly stratified, it is to be expected that the vertical variation in velocity will be greater than normal. This was so, for between 21h. and 22h. G.M.T. the speed at 150 feet was averaging 26 miles per hour, while at 50 feet it was averaging only 18 miles per hour, whereas, the normal reduction of a 26 miles per hour wind at 150 feet is 21 miles per hour at 50 feet. There thus was a tendency for the layers moving with different speeds to set up frictional eddies, but it is difficult to believe that such frictional eddies should grow to a size sufficient to give the variations shown on the anemogram.

Unusually Red Sunrises and Sunsets over the Atlantic and in the London Area.

With the introduction during the summer of 1924 of a new Ships' Code for the transmission of wireless weather reports provision was made for reporting "unusual phenomena," one of these being the occurrence of unusually red sunrises and sunsets. Six years' records being now available, and with a change taking place in the present Ships' Code on May 1st, 1930, which does not provide for the reporting of unusual phenomena, the records of unusually red sunrises and sunsets have been extracted. The observations are comprised mainly within an area situated between Lat. 41°N. and 56°N., and Long. 11°W and 39°W. With the exceptions of August 16th, 1927, and May 8th, 1929, all the records are isolated ones, an unusually red sunrise or sunset being reported only by a single ship. On the former date, at 7h., s.s. *Montnairn* Lat. 52°N. Long. 17°W., and s.s. *Berengaria* Lat. 49°N. Long. 13°W., reported that they had previously experienced an unusually red sunrise. On the latter date, at 7h., s.s. *Montclare* Lat. 50°N.

Long. 23°W., and s.s. *Homeric* Lat. 44°N. Long. 35°W., both reported the previous occurrence of the same phenomenon. On June 23rd, 1925, s.s. *Olympic* reported both sunrise and sunset as unusually red.

TABLE 1.—ANNUAL SEASONAL DISTRIBUTION OF UNUSUALLY RED SUNRISES AND SUNSETS OVER THE ATLANTIC.

	Sunrise					Sunset				
	No.	Outward	Precipitation followed	Inward	Precipitation followed	No.	Outward	Precipitation followed	Inward	Precipitation followed
Winter										
1924-5	3	—	—	3	2	2	1	1	1	1
1925-6	0	—	—	—	—	1	—	—	1	1
1926-7	0	—	—	—	—	2	1	0	1	0
1927-8	1	1	1	—	—	3	2	1	1	0
1928-9	2	2	1	—	—	4	3	1	1	0
1929-30	5	3	3	2	1	2	—	—	2	2
Total	11	6	5	5	3	14	7	3	7	4
Summer										
1924	3	3	2	—	—	1	—	—	1	1
1925	8	2	0	6	5	2	—	—	2	0
1926	7	5	4	2	1	3	2	1	1	1
1927	8	4	1	4	3	0	-	—	—	—
1928	9	5	3	4	4	0	—	—	—	—
1929	9	1	1	8	6	2	2	2	—	—
Total	44	20	11	24	19	8	4	3	4	2

TABLE 2.—MONTHLY DISTRIBUTION.

Winter						Summer					
	Sunrise	Sunset		Sunrise	Sunset		Sunrise	Sunset		Sunrise	Sunset
Oct.	0	3	Jan.	3	2	April	5	0	July	6	1
Nov.	3	3	Feb.	0	2	May	11	0	Aug.	8	1
Dec.	2	3	Mar.	3	1	June	4	3	Sept.	10	3

Tables 1 and 2 show the annual and monthly seasonal distribution of unusually red sunrises and sunsets, reported from the Atlantic, during the period referred to above. The columns "inward" and "outward" in Table 1 indicate respectively ships on passage eastward or westward. Subsequently reported precipitation, or the absence of same, is limited in time to the next ensuing sunrise following an unusually red one, and similarly in the case of sunset. Table 1 shows that there is a marked predominance of unusually red summer sunrises, and a very limited number of unusually red summer sunsets. In winter there is a reversal, but the contrast is not so well marked.

From Table 2 it is seen that nearly half the reported unusually red summer sunrises are distributed between the months of May and September. The subsequent percentage frequency of precipitation is highest, following an unusually red summer sunrise, with ships inward bound when it amounts to 79 per cent; outward, the frequency falls to 55 per cent. Following an unusually red winter sunrise there is a reversal; outward, the subsequent percentage frequency of precipitation reaches 83 per cent, inward 60 per cent.

From the limited number of observations of unusually red winter and summer sunsets it appears that the chance of succeeding precipitation, or its absence, is about equal, both for outward and inward ships.

TABLE 3.—ANNUAL SEASONAL DISTRIBUTION OF UNUSUALLY RED SUNRISES AND SUNSETS IN THE LONDON AREA.

	Sunrise		Sunset			Sunrise		Sunset	
Winter	No.	Precipitation before next sunset	No.	Precipitation before next sunrise	Summer	No.	Precipitation before next sunrise	No.	Precipitation before next sunset
1924-5	7	6	4	2	1924	7	4	8	5
1925-6	6	6	7	1	1925	2	2	7	1
1926-7	7	6	8	2	1926	3	1	9	3
1927-8	13	9	7	2	1927	4	3	12	5
1928-9	4	3	0	—	1928	8	5	12	5
1929-30	9	8	7	1	1929	0	—	2	1
	46	38	33	8		24	15	50	20

TABLE 4.—MONTHLY DISTRIBUTION.

Winter						Summer					
	Sun-rise	Sun-set		Sun-rise	Sun-set		Sun-rise	Sun-set		Sun-rise	Sun-set
Oct.	7	6	Jan.	10	9	April	5	7	July	3	4
Nov.	8	4	Feb.	4	6	May	2	8	Aug.	7	8
Dec.	9	4	Mar.	8	4	June	2	10	Sept.	5	13

Tables 3 and 4 contain similar records for the London area.

In contrast with the ships' observations it is seen from Table 3 that unusually red summer sunrises are most infrequent and unusually red summer sunsets most frequent. The monthly distribution, in Table 4, also differs materially. There is a pronounced winter maximum for both sunrise and sunset in January. During the summer months August shows a maximum for sunrise and June and September for sunset. Unusually red winter sunrises were followed by precipitation in 83 per cent of the cases, winter sunset in 24 per cent. For summer sunrise, precipitation followed in 64 per cent, summer sunset, 40 per cent.

TABLE 5.—SEASONAL PERCENTAGE FREQUENCIES OF THE SKY TYPES ASSOCIATED WITH UNUSUALLY RED SUNRISES AND SUNSETS.

	No.	1	2	3	4	5	6	7
		%	%	%	%	%	%	%
Winter								
Sunrise	46	11	2	4	39	24	4	16
Sunset	33	9	0	3	46	6	18	18
Summer								
Sunrise	24	21	0	0	25	33	8	13
Sunset	50	8	0	2	32	22	18	18

In Table 5 the sky types, 7 in number, expressed as a percentage frequency, associated with unusually red sunrises and sunsets are set out. There is no record of an unusually red cloudless sunrise or sunset for either season.

The numbers in this table have the following meaning attached to them :—

1 = High cloud cirrus, cirro-stratus, cirro-cumulus, singly or in combination.
2 = Middle cloud, alto-cumulus, alto-stratus, singly or in combination.
3 = Low cloud, cumulus, cumulo-nimbus, fracto-cumulus, fracto-nimbus, nimbus, strato-cumulus, stratus, singly or in combination.
4 = High, middle and low cloud, combinations of 1, 2 and 3.
5 = High and middle cloud, combinations of 1 and 2.
6 = High and low cloud, combinations of 1 and 3.
7 = Middle and low cloud, combinations of 2 and 3.

From the above classification it is apparent that unusually red sunrises and sunsets, both in winter and summer, occur most frequently with combinations of high, middle and low cloud (4). Actually, at summer sunrise, the preponderance is with a combination of high and middle cloud (5), high cloud (1) also showing a large frequency. Data, on the lines of the above, are not available from the ship's reports owing to the fact that their cloud observations refer to standard hours which do not, as a general rule, coincide with the time of either sunrise or sunset. The preponderance of unusually red summer sunrises reported from the Atlantic appears to indicate the presence of considerable amounts of high and middle cloud about this time, and, on the other hand, scarcity of unusually red sunsets favours the prevalence of much low cloud.

Assuming that unusual sky redness is an indication of the presence of moist warm equatorial air, the excess of red summer sunrises over the Atlantic may, in a measure, be attributable to this. Atmospheric pollution which may, to some extent, affect the land observations at winter sunrise and sunset, and also at summer sunset, but only slightly, if at all, at summer sunrise, cannot account for any excess of sky redness over the Atlantic.

On March 31st, 1930, s.s. *Caronia* Lat. 50°N. Long. 17°W. reported an unusually red sunrise; the phenomenon also occurred in the London area on the same date, and is the sole occasion during the period of similarity in the observations. Although the effects were the same the causes were different, as the pressure distribution for the day shows.

The term unusually red sunrise or sunset, as used for the London area, indicates sky and cloud in the east at sunrise, and the west at sunset as (1) unusually all red, or (2) unusually red. In the former, red or gradations of red are the sole composition, and in the latter gradations of red are predominant, but some other colour enters into the composition. The intensity of the red coloration, in both cases, determines whether the description "unusually" is applicable.

SPENCER RUSSELL.

Heavy Rainfall Near Whitby, July 20th—23rd, 1930

The striking feature of the rainfall which caused the serious floods in the valley of the River Esk, was its persistence. The amounts were large on each of the four days, July 20th-23rd, and increased fairly steadily up the valley especially on the 22nd, when over five inches was recorded. The rainfall records set out below have been kindly supplied by observers in the Esk Valley. The stations are arranged in order up the Valley :—

	July, 1930				Total
	20th	21st	22nd	23rd	20th-23rd
	in.	in.	in.	in.	in.
Whitley (Westhorpe)	2·27	1·47	1·28	·12	5·14
Aislaby (Park Hall)	2·60	2·46	3·11	·31	8·48
Sleights (The Hall)	2·48	2·44	3·01	·38	8·31
Egton Bridge (Bridgeholme) ...	2·44	2·62	4·07	·65	9·78
Glaisdale (The Gables)	2·17	2·24	3·68	·24	8·33
Danby School	2·46	2·25	5·20	1·13	11·04
Castleton	2·70	2·32	5·70	1·25	11·97

The amounts cover the 24 hours commencing at 9 a.m. G.M.T. on the day of entry.

Much smaller rainfall amounts were recorded to the south of the Esk Valley. At Pickering and Helmsley, some 10 miles to the south, the totals for July 20th-23rd were only 2·14in. and 1·80in. respectively. To the north and more especially the west the rainfall gradient was less steep. At Lockwood Reservoir, to the north of Castleton the amounts were 2·70in., 1·84in., 4·46in. and 1·11in., a total of 10·11in. At Kildale Hall, just to the west of the Esk Valley, the amounts were 2·28in., 2·03in., 4·55in. and 1·18in., a total of 10·04in. At Nunthorpe and Crathorne, further west, the totals were 4·70in. and 3·99in. respectively. Much damage by flooding also occurred therefore in the Leven Valley. In the Sleights to Castleton area the rain appears to have started about 15h. on the 20th and continued with but few breaks until noon on the 23rd. There was a definite break of a few hours on the evening of the 21st. At Sleights the observer notes that there was " never anything more than what I should call heavy rain," while at Danby School the rain of the 22nd is described as " incessant." The observers comment on the steadiness of the rain and the absence of intense falls.

It is reasonable to conclude from the table above that the rainfall of both the 20th and 21st exceeded two inches practically everywhere in the Esk Valley, while that of the 22nd exceeded four inches over most of the upper half of the valley. Few streams could be expected to cope with the widespread fall of over eight inches in three days without serious flooding. The highest flood occurred early on the 23rd, following the heavy rainfall on the 22nd on ground already saturated by the rain of the two previous days. The Egton and Sleights bridges gave way about 5h. on the 23rd. Subsequently the level of the river fell rapidly. The most severe flooding naturally occurred in the lower Esk Valley, notably between Sleights and Whitby. An unprecedented feature was the use of the Whitby lifeboat at Ruswarp, two miles inland, where it was launched from its carriage over flooded fields for rescue work. The bridge at Sleights carried two water mains to supply Whitby, and these were severed when the bridge broke, reducing the town to 48 hours' supply. The supply was restored, however, with the aid of the Royal Engineers from Catterick Camp.

The heavy rain was due to a depression which persisted off the east coast of Lincolnshire from the morning of the 21st to the 24th and maintained strong northerly winds over the north Yorkshire Wolds. The distribution of the rainfall was controlled to a large extent by the configuration of the land, the largest amounts occurring over the more elevated parts of the moors and the least rainfall immediately to the south.

J. GLASSPOOLE.

Official Notice

Course of Training for Observers

It is proposed to hold a course of training for observers at climatological stations on Monday and Tuesday, September 23rd and 24th, 1930, at Kew Observatory, Richmond.

Subject to limitations of space at the Observatory, the course will be open to all climatological observers in connexion with the Meteorological Office. There will be no fee.

Admission to the course will be by ticket, which may be obtained on application to the Director, Meteorological Office (M.O.7), Air Ministry, Kingsway, London, W.C.2, from whom further information regarding the course may also be obtained.

Official Publication

The following publication has recently been issued.

The Weather Map. An introduction to modern meteorology. 2nd edition. (M.O. 225i.)

In view of the wide interest taken in weather forecasts and maps, the Meteorological Office have just issued a new edition of their publication " The Weather Map," which first appeared 15 years ago, and since that time has had a large sale. The new edition, which has been completely rewritten and consists of 83 octavo pages together with a number of maps, commences with a short historical summary describing the progress made from the year 1688, when the first-known weather map was published, down to the present date. The method of constructing a modern daily weather map is then described in detail, reference being also made to the method of taking the observations. Chapters follow on the weather associated with depressions and other pressure systems, and on modern methods of forecasting, while the book concludes with a discussion of some typical forecasts for the British Isles. It should appeal to a wide public.

Correspondence

To the Editor, *The Meteorological Magazine*

Dry Junes

There is no doubt that June is becoming an increasingly dry month. The total rainfall of the last 12 Junes was more than 7in. less than that of the 12 preceding Junes, 1906-18. The June average at the end of 12 years' readings here (1906-18) was 2·29in.; at the end of 24 years (1906-30) it is only 1·99in. In 1925 it provided the only absolutely rainless month in 36 years' observations, the last 24 being at this station. This year May and June have only yielded 1·86in. compared with 5·54in. last year in the dry January-September spell, but the January-June fall this year is still above the normal. The increasing dryness of June is proving disastrous to field and garden.

R. P. DANSEY.

Kentchurch Rectory, Hereford. July 7th, 1930.

Halos at Kashgar

By courtesy of Mr. A. Nimmo we have received a description and sketch of a system of solar halos observed by his nephew, Mr. G. Sherriff, at Kashgar, in Eastern Turkestan, on April 26th, 1930, from 7h. to 8h. The system consisted of the halos of 22° and 46°, each surmounted by a small tangent arc, the lower one subtending an angle of about 10°, the higher one about 30°. The halos showed faint prismatic colours, which were stronger at the contact of the 22° halo with its tangent arc. The air was hazy and in the haze two luminous uncoloured patches appeared just outside the 22° halo on either side of and at the same height as the sun; these " mock suns " were also marked by brighter patches on the halo.

Evaporation from Raingauges

The article by Mr. A. J. Bamford in the *Meteorological Magazine* for May, 1930 (pp. 82-87), and particularly his remarks (pp. 83-84) on the evaporation of water from a self-recording raingauge call to mind a case experienced at Amman, Transjordan, in the early autumn of 1929.

Hyetographs in the Middle East Area are withdrawn from use and stored during the dry season: in September when the instrument was put into action again with a little water in it, it was found that the pen traces became lower every day and on some records dropped about half a millimetre of chart scale in twenty-four hours. Leakage in the copper container and/or float was suspected, but examination showed none, so careful tests were made. The container was detached, almost completely filled with water so as to give good pressure on the base and side seams, it was then kept under observation whilst standing on a pad of clean blotting paper which would have shown up any drops exuding from the base; the seam down the side showed no sign of leaking. The float was immersed in hot water and watched for air bubbles, none was seen, nor did any water find its way into the float when it was allowed to cool while still submerged.

These tests having revealed no leakage it was assumed that evaporation could have been the only explanation since no other instrumental faults were discovered. The hyetograph was reassembled with a small amount of water in it to bring the pen up to its correct position and a small quantity of paraffin was floated on the top of the water in the annular space surrounding the float: this appeared to give a complete cure of the trouble.

The Amman daily rate of evaporation was nearly equal to

Mr. Bamford's rate for a fortnight: assuming his observations were made near Colombo, the lower humidity and greater height (about 2,600ft. above M.S.L.) of Amman may have been the causes and, perhaps, duration of sunshine may be included since Amman appears to be less cloudy than Colombo; the maximum temperatures for both places are roughly comparable, but Colombo minima are higher.

The self-recording gauge at Amman was the ordinary Negretti & Zambra hyetograph of the type in common use by the Meteorological Office: it rested on a concrete slab, about eighteen inches square, which surrounded the open end of a buried drain pipe into which depended the copper container: the air around the latter changed slowly of course. The ground all round the gauge was hard baked with a dusty surface and reddish-brown in colour, bare but for very sparse camel thorn: in wet weather it becomes almost clay-like "sticky" mud—about half an inch of rain in twelve hours gives an almost water-logged state: it seems likely that the heat of the ground around the container may have played a part in aiding evaporation. The collecting funnel, cylinder and combined case for the working parts, with the cast-iron base on which they were mounted, formed a heavy mass of metal of large heat content: although coated with aluminium paint they became almost uncomfortably hot to the touch. Heat conductivity between the upper exposed parts and the underground container must have been slow since they were joined by but three small brass lugs and screws, apart from the float stem in light contact with its guide; it would be a simple matter to fit bolts and nuts passing through insulating bushes and washers which would reduce heat transference.

It is suggested that the heat absorption of all gauges could be reduced by a high polish—the maintenance of which would be one of the few jobs of work well done and enjoyed by cheap native labour, though maybe the glitter would attract thieves. Chromium plating would cut down the work of polishing to an occasional wiping with a damp cloth.

C. VAUGHAN STARR.

R.A.F. Station, Biggin Hill, Kent. June 23rd, 1930.

NOTES AND QUERIES

Raingauges in Frosty Weather

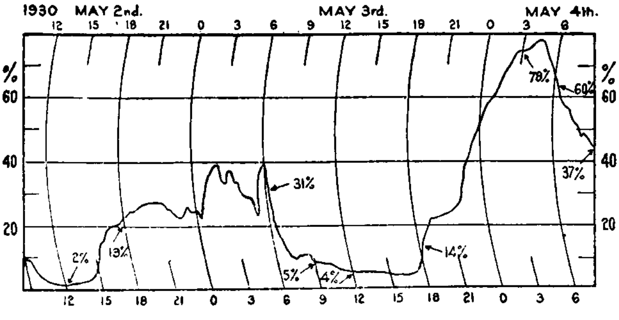
Writing with reference to Mr. Bilham's article in the *Meteorological Magazine* for December, 1929, on the protection of raingauges from damage in frosty weather Mr. Rakhahari Bakshi of Alipore Observatory has sent some notes in which he attacks the popular belief that water when freezing bursts the wall of the vessel by mass action.

Last year while working on secondary radiation in ice at different temperatures Mr. Bakshi had to prepare pure dust-free ice by freezing distilled water in evacuated bulbs. It was noticed that in the course of freezing a crust was first formed on the top of the water. The crust was always of hard ice, irregular underneath and about 5mm. thick. The water below the crust froze after a long time into a mass of beautifully transparent ice. Apparently in the course of freezing pressure is exerted on the glass wall as well as on the ice-coating. The adhesion between the glass wall and the ice-coating is sufficient to prevent the forcing up of the ice-coating. The glass wall can withstand a uniform pressure. The result is the "fracture" of the ice-coating—through which the expanded mass oozes up. The fracture of the ice-coating is always accompanied by great noise—the crust being left furrowed in consequence.

The cracks always occur just below the upper crust and usually have the appearance of the centre of a spider's web with many radiating lines about 5mm. in length. Cracks sometimes appear spontaneously after a long interval, even after a lapse of twenty hours. A direct proof that the cracks are due to the action of crystals is not possible, but the characteristic starlike forms can only be due to point pressure. A great internal pressure would rather break the glass into fragments. As the cracks occur in the zone where small crystals of ice are seen to grow it is likely that it is the pressure of crystals bearing on the ice that produces the cracks. The questions raised by Mr. Bakshi are of great interest and it is to be hoped that they will receive further examination.

The Accuracy of a Hair Hygrograph

We have received from Capt. J. Durward a copy of a record obtained at Heliopolis, Egypt, with a hair hygrograph. On the record he has written the corresponding values of relative humidity (per cent.) calculated from the readings of the wet- and dry-bulb thermometers. The agreement, as will be seen from the illustration, is remarkably close, in spite of the large range of humidity from 2 per cent to 78 per cent, and it will be admitted that the comparison reflects credit on the observers for their management of the instruments as well as on the accuracy of the hair hygrograph. Capt. Durward remarks that the figure of 2 per cent is the lowest relative humidity ever measured at Heliopolis.



A "Record" Gust

In a recent search for information about extreme wind speeds in the valleys of mountainous districts, I was interested to come upon a note of a gust apparently exceeding any of the well-known " record " gusts of the British Isles. During the period October, 1901, to February, 1902, Mr. R. C. Mossman made a series of observations at Achariach in Glen Nevis some 4¼ miles (in a direct line) to the south-east of Fort William: " it would hardly have been possible to have had a station more admirably placed for the study of valley conditions."* The more local surroundings of the observing site (150 feet above M.S.L.) were open, but the station was shut in, except along the narrow valley to northwestward, by high mountains with peaks ranging from 3,000 to 4,400 feet in height, within distances of 1¼ to 2 miles. For part of the time readings were made from the Dines Pressure Tube Anemometer of the type registering (*a*) velocity at the moment of reading; (*b*) the mean velocity, and (*c*) the maximum gust since last observation, the last registration being by means of a metal index. According to Mr. Mossman's description, " The feature of the wind is its gustiness, and these gusts are separated by long intervals of calm, or very light airs. The highest velocity recorded was 117 miles per hour on the morning of February 27th, at which time a full gale reaching force 10 at some hours was blowing from the south-east on Ben Nevis. The gale was severely felt in the Glen, and considerable damage was done at Glen Nevis House, where some buildings that had stood for twenty years were demolished about 8 a.m. The strength of the wind was found to vary greatly in different parts of the Glen, being greatest at such places as the Garochar and at the highest point of the carriage drive near Allt Eoghain, where a steady wind of force 8 to 9 was experienced. The highest mean velocity shown by the Dines anemometer for this day was 37 miles per hour from 10 a.m. to noon." I wrote to Mr. Mossman, who is now in Argentina, asking for further information regarding these observations; he very kindly gave me the particulars above quoted about the type of instrument in use, and added: " I do not think you should include this gust in an official list, because although the anchorage was very good the pole may have vibrated and vitiated the record. Further, on the barograph trace there is no record of unusual pumping. The squall was certainly a very severe one, as some wooden outbuildings at Glen Nevis House which had stood for about 20 years were blown down and carried across an adjacent meadow. I remember when I made the reading I was astonished at the high value recorded." In view of Mr. Mossman's remarks it is hardly felt that the gust could be claimed as the record in preference to certain other gusts of speeds ranging up to

---

* *Edinburgh, Proc. R. Soc. XLIV, p.* 633 *et seq.*

112 m.p.h., which in later years have been recorded on the anemographs from Dines pressure tube instruments. But at the same time the Glen Nevis gust and other general features of the Glen Nevis records demonstrate that however much the shelter of mountains may reduce the mean wind speed in the valleys the risk at least remains of the occurrence once in a while of a gust of practically the same order of force as those experienced in the most exposed places.

A. H. R. Goldie.

An Upper Air Temperature Indicator for Use with Pilot Balloons

In a recent paper* Mr. G. Chatterjee has described a temperature indicator for use with pilot balloons which has been successfully developed by the India Meteorological Department. The customary methods of obtaining upper-air temperatures by aeroplane or sounding balloon are expensive and in the latter case the readings are not available until some days or weeks after the ascent, rendering the method unsuitable for use in forecasting. The need for an indicator which will give the height at which some particular upper-air temperature is reached by a pilot balloon has often been felt and the method described by Mr. Chatterjee in detail appears to have met the need, at any rate so far as India is concerned. The instrument, which weighs 40 grams complete, consists of a simple bimetallic thermometer, shaped somewhat like an inverted letter U, the arms of which, as they separate, release a paper disc at a predetermined temperature. The paper disc carries a small tube of sulphuric acid which falls into a tray containing a mixture of potassium chlorate and sugar. The resulting combustion causes a puff of smoke which can be observed through a theodolite and also burns a string which releases the instrument with a flag from the balloon. This release is also observed. The tail method of observation enables the height of the balloon at the moment of release to be calculated. The temperature at which release takes place is determined by the size of the paper disc and these discs are made in various sizes, one being chosen in accordance with the particular temperature which it is desired to indicate. The height-temperature data which have been obtained in India by the method are stated to agree within 1°C. with those obtained by the Dines meteorograph.

It does not appear that any steps are taken to recover the instrument when it falls, and if used in this country the expense of the method would be by no means negligible. Probably this type of instrument can be made a good deal more

---

*An upper air temperature indicator for use with pilot balloon, by G. Chatterjee, *Gerlands Beiträge zur Geophysik*, Vol. 24 (1929), pp. 343-52.

cheaply in India, and the success obtained in a large number of ascents made at selected observatories in India appears to have fully justified the method.

Medical Climatology in Austria

The Bureau of Public Health in the Ministry of Social Administration, Vienna, sends us a series of reports, reprinted from the official journal "Mitteilungen des Volksgesundheitsamtes," in which the activities of this service are described. A number of stations have been established at levels up to 5,000 feet, furnished with autographic instruments for recording sunshine, temperature and humidity, rain- and snow-gauges, anemometer and also a katathermometer, wedge photometer and scale for measuring the blue of the sky. The investigations are specially directed towards the establishment of health resorts, especially sanatoria for tuberculosis.

The reports hitherto received include an introductory statement of the programme by Dr. V. Conrad, a report on a year of climatic observations in Gargellen (Montafon) a report on the climate of Grafenhof-St. Veit (Salzburg), a paper on the rate of cooling in the rest-room of the curative station for consumptives at Grafenhof and the temperature sensations of the patients (in which observations with the katathermometer were largely used), a report on the climatic observations on the Muttersberge, near Bludenz, in Vorarlberg, measurements of radiation on Semmering, measurements of water temperature in public bathing places in lakes in the Austrian Alps, and a brief preliminary account of methods of investigation into the physical and chemical characteristics of mud-baths.

Reviews

The Climate of the Netherlands. C. Air pressure, D. Wind. By Dr. C. Braak. K. Ned. Meteor. Inst. No. 102. Med. en Verh. 32. Size 9½in. × 6¾in., pp. 117 (Dutch) + 41 (English Summary). *Illus.* Batavia, 1929.

The preparation of a handbook on the climate of the Netherlands, by the Royal Meteorological Institute of De Bilt, began several years ago. In 1913 appeared the section on rainfall and in 1920 that on temperature; these were under the authorship of Dr. Hartman, and included translations in French. The present section on air pressure and wind is by Dr. C. Braak and includes a summary, rather than a full translation, in English, but it seems likely that no information of importance has been omitted.

Average values of pressure at five stations are given, based on observations since 1901, the year when accurate standardisation of barometers began. The figures for diurnal variation are mostly based on shorter periods, while for absolute extreme values of pressure a series of combined observations, at Utrecht and De Bilt since 1848, is used. Examination of the tracks frequented by depressions in Holland and neighbouring regions leads to a modification of the results usually quoted on the authority of van Bebber, as for instance in Hann-Süring's *Lehrbuch.*

The annual and diurnal variations of wind velocity and direction are very fully discussed, with tables and diagrams. A table is included showing averages of wind velocity reduced to a level of 6 metres above ground. In the case of De Bilt, for instance, winds of force 5 and 6 at the 20-metre level are reduced to the 6-metre level by subtracting 15 per cent. The reduction factors are based on the work of Hellmann, Dines and others, but how far results obtained near Berlin, say, may be taken as valid for stations near the coast of Holland is open to argument, as is indeed admitted in the text. The uncorrected figures being given, however, the reader may use which he pleases. The remainder of the English text is devoted to descriptions of some noteworthy gales and a note on whirlwinds, it being stated that during the period 1888-1913 Holland experienced whirlwinds of more or less importance on an average of 8 days a year. This work forms a valuable discussion of pressure and winds in Holland. Several previous reviews in this magazine have complimented Dr. Braak on his command of the English language; in this case he again deserves the thanks of all those English-speaking meteorologists who have not an equivalent knowledge of the Dutch language.

S. T. A. MIRRLEES.

La Mécanique Différentielle des Fronts et du Champ isallobarique. Par Antonio Gião. Mémorial de l'Office National Météor de France, No. 20, *Paris,* 1929.

The author of this work has for some years made a study of methods of forecasting practised in different Continental countries. In France special attention is paid to pressure changes, shown by isallobars, while in Norway the chief emphasis is on the discontinuities, or "fronts," separating different air masses. The memoir under review aims at a synthesis of the two methods, by means of an analytical discussion of the changes of pressure in relation to the fronts. General Delcambre, the Director of the French Meteorological Office, contributes a preface, and this is followed by a short introduction by Dr. J. Bjerknes. Both writers speak in terms of high praise of M. Gião's work.

The memoir is worth the attention of those who wish to increase their familiarity with the theoretical aspects of fronts, and with the type of analysis involved. The style is very clear, and the analysis quite straightforward, but nevertheless a shorter work would have appealed to a larger number of readers. It is useful to have a mathematical discussion of this subject, but, as in almost every branch of meteorology, the complete mathematical expressions are complex, and simplifications have to be introduced. In a paper containing some hundreds of equations it is not always easy to know on what assumptions any particular formula is based.

The initial line of attack is the consideration of two adjacent infinitesimal elements, one on each side of an idealised surface of discontinuity, at a particular instant. These elements have equal pressures and equal components of velocity and acceleration normal to the surface of discontinuity, although they are moving on different tracks, with different components of velocity and acceleration in other directions. From these facts and from the equations of notion, it is possible to deduce various relationships. From p. 39 onwards, most of the formulæ are expressed as far as possible in terms of the pressure and its changes, since this is the variable which can be observed most accurately, and which is least dependent on purely local and superficial effects. The fundamental relations are derived by a method similar to that mentioned above, but for the most part in two dimensions only. The front is taken at right angles to the x-axis, and we have the equation—

$$\left(\frac{\delta p}{\delta t}\right)_f = \frac{\delta p_1}{\delta t} + u_f \frac{\delta p_1}{\delta x} = \frac{\delta p_2}{\delta t} + u_f \frac{\delta p_2}{\delta x}$$

The left-hand term gives the change of pressure on either element, moving along with the front with velocity u_f, while the suffixes 1 and 2 refer to the separate elements. For simplicity we may consider a V-shaped trough with the isobars on each side making an acute angle with the front. Then the element in advance of the front is moving towards higher pressure, and the term $u_f \frac{\delta p}{\delta x}$ is positive, whereas the corresponding term for the element in the rear is negative. The terms $\frac{\delta p}{\delta t}$ are of course always different on the two sides, and in the special case when the pressure at the moving front is not changing, they cancel out the others. If we ignore details of structure, which do not enter into the idealised front, the motion u_f does not in general correspond with that of any element of air, so that it is difficult to attach a physical meaning to the different terms. The equations admit of considerable development in terms of the pressure gradients and their changes and of the fields of isallobars. Somewhat similar methods are adopted in the case of temperature distribution, and the sharpening or smoothing out of fronts. The adiabatic relation between pressure and temperature is considered in detail.

The more complex equations are simplified by rejecting the smaller terms. Hesselberg and Friedmann's figures for the order of magnitude of the different terms are used more than once. On p. 25 a six term expression for the acceleration of the front is much simplified for the earth's surface by assuming that the vertical velocity is zero, and the same assumption is sometimes made later on. The assumption is not in general justifiable when applied to a front, as it ignores the convergence to the front. Later in the paper it is shown from anemograms that the difference between the wind components normal to the front on the two sides is small. This one would expect, since the component of pressure gradient is the same, but unfortunately the small difference is important for the problems considered in this memoir.

The equations are of course based on infinitesimals, but they can be adapted to actual weather maps by the introduction of approximate methods based on finite differences. Dr. Bjerknes, in his introduction, states that some of the formulæ led to successful 12-hour forecasts at Bergen. Further developments will be awaited with interest.

From the examples given by M. Giāo, it is by no means self-evident that the use of the formulæ would lead to an improvement on the methods now in use, which really consist of extrapolations from the previous movements of the front, and from the changes of pressure and of gradients. Roughly speaking, present methods deal with phenomena *in toto*. Whether analytical methods would give better results is likely to depend on how far the separate terms obtained in the analysis correspond with physical realities.

In the final chapter the author discusses the forecasting problem and expresses the opinion that the study of fronts and of air masses on the earth's surface provides the most hopeful line of advance. He considers that in spite of surface friction the conditions at the ground are less complex than those up aloft, the main reason being the absence of vertical motion. The reviewer cannot agree with this opinion. The primary units of atmospheric circulation, the cyclone and the anticyclone, seem to present three-dimensional problems, insoluble from a consideration of surface conditions alone.

C. K. M. DOUGLAS.

Books Received

Man and his climatic environment in the Tropics. By Prof. R. de C. Ward.

The acclimatization of the white race in the Tropics. By Prof. R. de C. Ward.

Résumés mensuels et annuels des Observations Météorologiques faites aux stations de 11 *ordre du Réseau de l'Observatoire Geophysique á l'Oriente Lointain.* Année 1919. Fascicule III. Vladivostok, 1929.

Some of the Work of the Geophysical branch of the Solovetski Society for local observations, by A. G. Sanin (in Russian). Solovetsk Islands, 1929.

Deutsches Meteorologisches Jahrbuch, 1928, Freie Hansestadt Bremen. Edited by Dr. A. Mey, Jahrgang xxxix, Bremen, 1929.

Obituary

Father José Algué, S.J.—Born at Barcelona on December 28th, 1856, José Algué began his studies at the Colegio de San Ignacio and early came under the influence of the Rev. Don José Faura, brother of the founder and first Director of the Observatory of Manila in the Philippine Islands. His interests took a scientific turn, including mathematics, physics and chemistry, and in 1889 he was selected by the superiors of the Compañia de Jesús to collaborate in the work of the Observatory. In 1891 he visited the United States to study astronomy and in 1893 he took an active part, on behalf of Spain and the Philippines, at the International Meteorological Congress which met at Chicago. Ater this Congress he returned to Spain, and thence proceeded to Manila as Assistant Director of the Observatory under Father F. Faura.

The year 1894 was remarkable for an extraordinary number of typhoons, and Father Algué immediately commenced the study which became his chief work. His first essay appeared in 1895, followed in 1897 by " Baguios o ciclones filipinos " and " El Barociclonómetro." The same year, on the death of Father Faura, he became Director of the Observatory. In 1904 followed his famous monograph " Cyclones of the Far East," indispensable for all subsequent studies of the phenomena of tropical cyclones. This work was written in English but has been translated into several other languages. Other meteorological work was not neglected, however; as early as 1898 he published a paper on " The clouds of the Philippine Archipelago." The network of stations and the meteorological service of the Philippines was continually expanded, including the erection in 1907 of the high-level observatory of Mirador, at a height of 1,512 metres, and Father Algué was a regular attendant at the International Meteorological Conferences. In 1906 he was elected an Honorary Member of the Royal Meteorological Society, and he has made three contributions to the pages of the *Quarterly Journal.* In 1924 he again visited Europe to organise the Philippine exhibit at the Vatican missionary exhibition of 1925, and then ill-health made it impossible for him to return to Manila. He died at Roquetas on May 27th, 1930.

News in Brief

According to a note from the Norddeutscher Lloyd in the *Meteorologische Zeitschrift* for May, 1930, so-called pilot balloon stations have been instituted on some German liners from which, weather permitting, one or more balloons are sent up daily. One of these vessels is the *Sierra Morena*, on which observations up to 16,000m. have already been made.

Erratum

July, 1930, p. 133, line 4, for " 49°F. at 1h." *read* " 39°F. at 1h."

The Weather of July, 1930

The most noteworthy features of the month were the prolonged period with day temperatures below normal, the heavy rainfall in parts of England and south Scotland and the excessive number of days on which thunderstorms occurred. An indefinite ridge of relatively high pressure across England with a stationary depression to the northwest gave warm sunny weather generally in England for the first week though slight rain occurred locally. In Scotland and Ireland the weather was more unsettled with showers and bright intervals. Heavy rain, however, fell at a few places on the 2nd-4th, including 1·68in. at Rathnew, Co. Wicklow on the 3rd. Thunderstorms occurred in Scotland and north England on the 1st-4th and in eastern England on the 1st. Temperature was high during this time reaching 79°F. at Hull on the 2nd, 81°F. at Tottenham on the 5th, 82°F. at Norwich on the 6th and 80°F. at Southampton on the 9th. The depression centred near Iceland moved southeastward on the 9th and with northerly winds over the British Isles, temperature fell markedly that evening. The weather continued sunny in the north and west for a day or two but much cloud and local severe thunderstorms were experienced in the east and south on the 10th and 11th. The 5th, 6th and 7th were the sunniest days of the month in south England and the 11th and 12th in north England and Scotland, 15·1hrs. of bright sunshine occurring at Oxford on the 5th, at Hastings on the 6th and at Rothesay on the 11th. Subsequently with depressions moving slowly and erratically across the country, the weather became unsettled and cool, with a general deficiency of sunshine. Except for the 13th, day temperatures remained generally below normal to the end of the month. The 22nd and 23rd were the coldest days, many places in the Midlands reporting maxima of only 51°F. Rain fell on most days between the 12th and 31st with frequent thunderstorms but there were many long bright periods between. The sunniest days were the 17th, 19th, 25th, 27th and 31st, 14·9hrs. occurred at Deerness on the 25th, 14·4hrs. at Shoeburyness on the 27th and 12·0hrs. at Collumpton on the 19th and at Bath on the 31st. Thunderstorms were most widespread over Great Britain on the 29th and 30th. The rainfall amounts were generally small, except for isolated falls (2·00in. fell at Lincomb Lock, Worcester, on the 13th, 2·89in. at Castle Caulfield, Co. Tyrone, on the 16th and 2·0in. at Berwick-on-Tweed on the 17th), and for the extremely heavy falls which occurred over the area extending from Norfolk and Brecon to Aspatria and Durham from the 20th to 23rd. The heaviest and most continuous rain of this period fell in the North Riding, Yorkshire, where there was severe flooding.* Except for Aberdeenshire, the London area and parts of Cornwall the total rainfall for the month was above normal. The distribution of sunshine was as follows—

	(hrs.)	(hrs.)		(hrs.)	(hrs).
Lerwick	111	— 41	Liverpool	146	−47
Aberdeen	157	— 2	Ross-on-Wye	177	—22
Dublin	128	— 42	Falmouth	231	+ 6
Birr Castle	94	— 50	Gorleston	177	—54
Valentia	119	— 40	Kew	173	—28

Pressure was below normal over western Europe (except the Iberian Peninsula) and the Azores, the greatest deficits being 6·3mb. at Brest and 6·1mb. at The Helder, while pressure was above normal over Spitsbergen, northern Iceland, the Iberian Peninsula and most of the North Atlantic, the greatest excess being 3·8mb. at Jan Mayen. Temperature was above normal in Spitsbergen, Scandinavia and Portugal and below normal in central Europe, while rainfall was deficient in Spitsbergen and northern Scandinavia and in excess in southern Scandinavia and central Europe. The total rainfall was about twice the normal in south Scania and Dalsland but only 60 per cent of the normal in Norrland.

Thunderstorms were experienced in Belgium on the 1st and a hailstorm ruined most of the grape crop in the Vauvray district of France on the 2nd. Warm weather was experienced in Hungary early in the month. On the 6th a waterspout occurred between Lausanne and Vevey and torrential rain, accompanied by gales fell over Switzerland on the 11th and 12th causing floods. On the 13th there was heavy snow in Switzerland with a considerable drop in temperature. Great heat was experienced throughout Portugal about the 15th. A forest fire broke out between Saint Raphael and Valescure on the 15th, but was extinguished the following day. Heavy rain caused damage to crops again in Switzerland about the 25th. The Rhone and the Arve were both rising rapidly and floods were reported from Haute Savoie and Canton Ticino. A cyclone swept over Adrianople on the 26th causing loss of life and material damage.

---

*See p. 158.

A severe typhoon swept across Kiushiu, the southernmost island of Japan, and northwards along the eastern coasts of Korea on the 18th. Over 400 people were killed, mainly in Korea, and great material damage was done both on the sea and land. Severe floods occurred on the Indus, near Shikarpura and Larkana on the 25th. The flood water was diverted from the towns then, but heavy rain continued for some days and by the 31st the situation was much worse. Shikarpura was nearly surrounded by deep water, and water from the hilly Baluchistan tracts was coursing through Jacobabad. The villages of Jhatpat and Mamal were submerged and the thousands of refugees from Shikarpura, Sultankot and Khanpur were in peril.

The South Australian drought was broken by a fall of between 1 and 2in. of rain between the 1st and 3rd. Further general rains in South Australia towards the end of the month greatly benefited the wheat and pastoral lands.

Hail caused much damage to the crops in the Prairie Provinces, Canada, about the 11th and again in Saskatchewan on the 17th. Warm wather was experienced in British Columbia early in the month. A severe thunderstorm occurred in New York on the 3rd. Temperature was above normal in the west of the United States during the first week of the month and this heat spread to the east for the rest of the month. During the heat wave 106°F. was recorded at Washington, D.C., on the 20th and 98°F. at New York on the 21st. After this there was a slight fall in temperature but it still remained above normal. Rainfall was generally deficient. Rather cool dry weather prevailed generally in the Argentine during the first three weeks of the month.

The special message from Brazil states that the rainfall in the northern and central regions was scarce with averages 1·57in. and 0·47in. below normal respectively, while in the southern regions the distribution was irregular with an average almost normal. Four large anticyclones passed across the country. Gales were experienced along the coast southwards from Cabo Frio. Crops were generally affected by the lack of rain and the vegetables in the south harmed by the frost. At Rio de Janeiro pressure was 1·6mb. below normal and temperature 1·6°F. above normal.

Rainfall, July, 1930.—General Distribution

England and Wales	143	per cent of the average 1881-1915.
Scotland	95	
Ireland	113	
British Isles	124	

Rainfall: July, 1930: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square..........	2·00	84	*Leics* .	Belvoir Castle............	3·20	132
Sur .	Reigate, Alvington.....	2·89	128	*Rut* .	Ridlington................	3·09	...
Kent .	Tenterden, Ashenden...	3·36	161	*Linc* .	Boston, Skirbeck........	2·46	112
,, .	Folkestone, Boro. San..	2·35	...	,, .	Cranwell Aerodrome...	3·58	153
,, .	Margate, Cliftonville...	2·10	106	,, .	Skegness, Marine Gdns	4·41	203
,, .	Sevenoaks, Speldhurst	2·43	...	,, .	Louth, Westgate........	5·35	214
Sus .	Patching Farm.........	2·34	97	,, .	Brigg, Wrawby St.....	5·50	...
,,	Brighton, Old Steyne..	2·30	106	*Notts* .	Worksop, Hodsock.....	5·92	260
,,	Heathfield, Barklye....	3·42	137	*Derby* .	Derby, L. M. & S. Rly.	5·70	240
Hants .	Ventnor, Roy. Nat. Hos.	1·56	77	,, .	Buxton, Devon Hos....	6·91	176
,, .	Fordingbridge, Oaklnds	2·18	109	*Ches* .	Runcorn, Weston Pt...	5·18	188
,, .	Ovington Rectory.......	2·26	88	,, .	Nantwich, Dorfold Hall	7·02	...
,, .	Sherborne St. John.....	1·69	76	*Lancs* .	Manchester, Whit. Pk.	...	...
Berks .	Wellington College.....	2·56	124	,, .	Stonyhurst College.....	5·99	155
,, .	Newbury, Greenham...	2·34	106	,, .	Southport, Hesketh Pk	3·46	121
Herts .	Welwyn Garden City...	2·88	...	,, .	Lancaster, Strathspey	3·30	...
Bucks .	High Wycombe..........	3·02	153	*Yorks* .	Wath-upon-Dearne.....	5·65	225
Oxf . .	Oxford, Mag. College..	2·86	127	,, .	Bradford, Lister Pk....	5·81	211
Nor .	Pitsford, Sedgebrook...	2·88	122	,, .	Oughtershaw Hall......	6·18	...
,, .	Oundle.....................	1·90	...	,, .	Wetherby, Ribston H.	5·28	211
Beds .	Woburn, Crawley Mill	2·43	109	,, .	Hull, Pearson Park.....	4·70	201
Cam .	Cambridge, Bot. Gdns.	3·06	142	,, .	Holme-on-Spalding.....	4·79	...
Essex .	Chelmsford, County Lab	2·72	128	,, .	West Witton, Ivy Ho.	4·04	...
,, .	Lexden Hill House....	3·67	...	,, .	Felixkirk, Mt. St. John	6·89	252
Suff .	Hawkedon Rectory.....	4·54	186	,, .	Pickering, Hungate....	4·02	...
,, .	Haughley House........	3·69	...	,, .	Scarborough.............	5·63	231
Norf .	Norwich, Eaton.........	...	..	,, .	Middlesbrough..........	4·89	191
,, .	Wells, Holkham Hall	...	...	,, .	Baldersdale, Hury Res.	5·03	...
,, .	Little Dunham..........	5·42	197	*Durh* .	Ushaw College...........	5·79	207
Wilts .	Devizes, Highclere......	2·11	91	*Nor* .	Newcastle, Town Moor	3·99	151
,, .	Bishops Cannings.......	3·17	127	,, .	Bellingham. Highgreen	6·28	...
Dor .	Evershot, Melbury Ho.	3·06	121	,, .	Lilburn Tower Gdns....	6·83	...
,, .	Creech Grange..........	1·89	...	*Cumb* .	Geltsdale.................	7·63	...
,, .	Shaftesbury, Abbey Ho.	1·56	61	,, .	Carlisle, Scaleby Hall	6·32	193
Devon .	Plymouth, The Hoe....	2·08	75	,, .	Borrowdale, Seathwaite	6·10	72
,, .	Polapit Tamar...........	2·39	89	,, .	Borrowdale, Rosthwaite	...	...
,, .	Ashburton, Druid Ho.	2·96	97	,, .	Keswick, High Hill.....	4·21	...
,, .	Cullompton..............	1·89	70	*Glam* .	Cardiff, Ely P. Stn.....	3·04	98
,, .	Sidmouth, Sidmount...	1·57	63	,, .	Treherbert. Tynywaun	8·63	...
,, .	Filleigh, Castle Hill....	2·89	...	*Carm* .	Carmarthen Friary.....	4·56	130
,, .	Barnstaple. N. Dev. Ath.	2·53	94	,, .	Llanwrda.................	6·00	138
Corn .	Redruth, Trewirgie.....	2·91	95	*Pemb* .	Haverfordwest, School	...	...
,, .	Penzance, Morrab Gdn.	3·01	111	*Card* .	Aberystwyth............	4·21	...
,, .	St. Austell, Trevarna...	3·62	108	,, .	Cardigan, County Sch.	3·15	...
Soms .	Chewton Mendip........	3·61	103	*Brec* .	Crickhowell, Talymaes	5·40	...
,, .	Long Ashton............	2·38	...	*Rad* .	Birm W. W. Tyrmynydd	6·88	167
,, .	Street, Millfield	1·77	...	*Mont* .	Lake Vyrnwy...........	5·31	155
Glos. .	Cirencester, Gwynfa....	3·35	130	*Denb* .	Llangynhafal............	3·82	...
Here .	Ross, Birchlea............	3·05	134	*Mer* .	Dolgelly, Bryntirion...	7·36	173
,, .	Ledbury, Underdown..	3·05	135	*Carn* .	Llandudno...............	1·78	74
Salop .	Church Stretton.........	5·36	219	,, .	Snowdon, L. Llydaw 9	.	...
,, .	Shifnal, Hatton Grange	5·25	233	*Ang* .	Holyhead, Salt Island	2·60	100
Worc .	Ombersley, Holt Lock	3·06	146	,, .	Lligwy....................	2·38	...
,, .	Blockley..................	3·87	..	*Isle of Man*			
War .	Farnborough.............	4·34	169		Douglas, Boro' Cem....	2·81	92
,, .	Birminghm, Edgbaston	4·46	192	*Guernsey*			
Leics .	Thornton Reservoir....	5·38	217		St. PeterP't. GrangeRd.	2·27	112

Rainfall : July, 1930 : Scotland and Ireland

Co.	STATION	In.	Per-cent of Av.	Co.	STATION	In.	Per-cent. of Av.
Wigt.	Pt. William, Monreith	2·59	...	*Suth* .	Loch More, Achfary	2·71	51
,, .	New Luce School	2·19	...	*Caith* .	Wick	1·36	52
Kirk .	Carsphairn, Shiel	5·81	...	*Ork* .	Pomona, Deerness	1·63	63
,, .	Dumfries, Cargen	...	...	*Shet* .	Lerwick	2·51	109
Dumf.	Eskdalemuir Obs.	5·61	137	*Cork* .	Caheragh Rectory	3·52	...
Roxb .	Branxholm	5·10	169	,, .	Dunmanway Rectory	3·76	96
Selk .	Ettrick Manse	4·58	...	,, .	Ballinacurra	2·34	84
Peeb .	West Linton	3·18	...	,, .	Glanmire, Lota Lo.	2·28	75
Berk .	Marchmont House	3·59	118	*Kerry*.	Valentia Obsy.	4·11	109
Hadd.	North Berwick Res.	4·01	155	,, .	Gearahameen	5·80	...
Midl .	Edinburgh, Roy. Obs.	3·90	148	,, .	Killarney Asylum	2·42	73
Ayr .	Kilmarnock, Agric. C.	2·50	80	,, .	Darrynane Abbey	2·36	62
,, .	Girvan, Pinmore	3·48	95	*Wat* .	Waterford, Brook Lo.	3·03	93
Renf .	Glasgow, Queen's Pk.	4·17	143	*Tip* .	Nenagh, Cas. Lough	4·06	129
,, .	Greenock, Prospect H.	3·04	78	,, .	Roscrea, Timoney Park	3·26	...
Bute .	Rothesay, Ardencraig.	4·52	114	,, .	Cashel, Ballinamona	3·47	120
,, .	Dougarie Lodge	2·60	...	*Lim* .	Foynes, Coolnanes	2·98	97
Arg .	Ardgour House	3·39	...	, .	Castleconnel Rec.	3·92	...
,, .	Manse of Glenorchy	4·13	...	*Clare* .	Inagh, Mount Callan	5·53	...
,, .	Oban	2·86	...	,, .	Broadford, Hurdlest'n.	4·05	...
,, .	Poltalloch	3·27	79	*Wexf*.	Newtownbarry	...	...
,, .	Inveraray Castle	6·30	127	,, .	Gorey, Courtown Ho.	2·99	102
,, .	Islay, Eallabus	3·14	92	*Kilk* .	Kilkenny Castle	3·08	109
,, .	Mull, Benmore	6·40	...	*Wic* .	Rathnew, Clonmannon	4·22	...
,, .	Tiree	...	...	*Carl* .	Hacketstown Rectory	5·22	151
Kinr .	Loch Leven Sluice	3·03	105	*Leix* .	Blandsfort House	3·82	124
Perth .	Loch Dhu	5·05	104	,, .	Mountmellick	3·72	...
,, .	Balquhidder, Stronvar	3·43	...	*Off'ly* .	Birr Castle	3·14	106
,, .	Crieff, Strathearn Hyd.	2·84	96	*Dubl* .	Dublin, FitzWm. Sq.	2·61	102
,, .	Blair Castle Gardens	1·77	69	,, .	Balbriggan, Ardgillan.	3·72	137
,, .	Glen Bruar, Bruar Ldg.	2·75	...	*Me'th* .	Beauparc, St. Cloud	3·28	...
Angus.	Kettins School.	2·45	104	,, .	Kells, Headfort	4·15	130
,, .	Dundee, E. Necropolis	2·30	84	*W.M* .	Moate, Coolatore	3·66	...
,, .	Pearsie House	2·75	...	,, .	Mullingar, Belvedere	4·24	133
,, .	Montrose, Sunnyside	1·89	72	*Long* .	Castle Forbes Gdns	3·26	105
Aber .	Braemar, Bank	2·89	112	*Gal* .	Ballynahinch Castle	5·76	139
,, .	Logie Coldstone Sch.	2·16	73	,, .	Galway, Grammar Sch.	3·54	...
,, .	Aberdeen, King's Coll.	1·41	50	*Mayo* .	Mallaranny	6·66	...
,, .	Fyvie Castle	3·41	...	,, .	Westport House	4·36	141
Moray.	Gordon Castle	4·13	129	,, .	Delphi Lodge	10·40	...
,, .	Grantown-on-Spey	...	...	*Sligo* .	Markree Obsy	5·14	148
Nairn.	Nairn, Delnies	2·46	92	*Cav'n* .	Belturbet, Cloverhill	3·86	124
Inv .	Kingussie, The Birches	2·84	...	*Ferm* .	Enniskillen, Portora	...	...
,, .	Loch Quoich, Loan	3·87	...	*Arm* .	Armagh Obsy	3·27	113
,, .	Glenquoich	3·39	53	*Down* .	Fofanny Reservoir	8·46	...
,, .	Inverness, Culduthel R.	3·09	...	,, .	Seaforde	4·19	131
,, .	Arisaig, Faire-na-Squir	2·35	...	,, .	Donaghadee, C. Stn	2·76	99
,, .	Fort William	2·74	...	,, .	Banbridge, Milltown	2·77	...
,, .	Skye, Dunvegan	1·33	...	*Antr* .	Belfast, Cavehill Rd	3·34	...
R & C.	Alness, Ardross Cas	2·59	85	,, .	Glenarm Castle	4·25	...
,, .	Ullapool	1·89	...	,, .	Ballymena, Harryville	4·11	120
,, .	Torridon, Bendamph	1·95	36	*Lon* .	Londonderry, Creggan	4·37	119
,, .	Achnashellach	3·64	...	*Tyr* .	Donaghmore	5·44	...
,, .	Stornoway	1·43	47	,, .	Omagh, Edenfel	3·75	110
Suth .	Lairg	2·09	...	*Don* .	Malin Head	3·04	...
,, .	Tongue	3·01	98	,, .	Dunfanaghy	2·66	...
,, .	Melvich	2·55	...	,, .	Killybegs, Rockmount.	4·71	107

Erratum : Castle Forbes Gdns., June, for 1·65/64 read 1·77/69.

Climatological Table for the British Empire, February, 1930.

STATIONS	PRESSURE Mean of Day M.S.L. mb.	PRESSURE Diff. from Normal mb.	TEMPERATURE Absolute Max. ° F.	TEMPERATURE Absolute Min. ° F.	TEMPERATURE Mean Values Max. ° F.	TEMPERATURE Mean Values Min. ° F.	TEMPERATURE Mean Values ½ max. and min. ° F.	TEMPERATURE Mean Values Diff. from Normal ° F.	TEMPERATURE Mean Wet Bulb ° F.	Relative Humidity. %	Mean Cloud Am'nt 0—10	PRECIPITATION Am'nt in.	PRECIPITATION Diff. from Normal in.	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible
London, Kew Obsy.	1018·2	+ 2·2	51	29	42·6	35·1	38·9	— 1·2	35·1	83	8·1	0·58	— 0·96	5	1·7	18
Gibraltar	1018·0	— 2·0	69	40	60·6	46·0	53·3	— 2·6	45·7	82	4·0	6·52	+ 2·30	12	..	..
Malta	1014·6	— 2·1	64	45	58·2	50·0	54·1	— 1·2	49·6	78	6·2	5·19	+ 2·99	15	5·9	55
St. Helena	1012·1	+ 2·1	..	58	..	59·7	..	..	60·9	95	8·1	0·98	— 2·82	12	..	..
Sierra Leone	1012·0	+ 1·2	95	71	88·1	73·9	81·0	— 1·3	73·9	76	3·5	0·15	— 0·15	1	..	..
Lagos, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1010·2	+ 2·3	89	56	79·8	63·8	71·8	— 0·2	..	81	6·5	10·86	+ 0·21	15	..	..
Salisbury, Rhodesia	1008·9	+ 1·3	86	51	81·1	59·6	70·3	+ 1·5	61·7	61	4·3	1·43	— 5·97	8	8·8	69
Cape Town	1015·0	+ 1·6	93	50	80·6	60·3	70·5	+ 0·2	61·7	73	2·9	1·09	+ 0·51	5	..	..
Johannesburg	1013·0	+ 1·1	89	44	76·9	55·4	66·1	+ 0·7	57·1	68	4·6	3·97	— 1·25	13	9·2	71
Mauritius	1010·6	— 0·4	87	66	84·0	73·0	78·5	— 0·8	75·2	78	6·5	5·38	— 3·02	22	7·8	61
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calcutta, Alipore Obsy.	1014·5	+ 1·2	93	51	83·3	61·4	72·3	+ 1·3	61·0	81	2·3	0·77	— 0·33	1*	..	..
Bombay	1013·6	+ 0·9	94	59	85·5	66·3	75·9	+ 0·3	63·4	65	0·5	0·00	— 0·03	0*	..	..
Madras	1013·3	+ 0·4	91	63	85·4	70·0	77·7	0·0	72·7	83	3·8	2·21	+ 1·89	5*	..	..
Colombo, Ceylon	1012·2	+ 1·1	93	68	87·6	72·3	79·9	+ 0·2	74·6	70	3·7	1·97	— 0·10	7	9·9	83
Hongkong	1019·1	+ 0·4	78	47	65·0	56·5	60·7	+ 1·6	56·1	72	6·3	1·38	— 0·22	7	5·6	49
Sandakan	..	..	88	72	86·3	73·2	79·7	— 0·4	75·7	79	..	2·37	— 7·25	6	..	..
Sydney, N.S.W.	1016·9	+ 2·8	106	59	78·7	66·9	72·8	+ 1·5	68·2	69	5·5	0·61	— 3·63	8	8·4	63
Melbourne	1016·2	+ 1·7	103	51	82·5	59·4	70·9	+ 3·5	61·8	57	4·9	2·70	+ 0·98	8	7·4	55
Adelaide	1014·9	+ 0·6	112	52	92·8	66·2	79·5	+ 5·4	64·0	36	3·1	0·43	— 0·23	3	10·2	77
Perth, W. Australia	1013·8	+ 0·8	102	53	84·3	62·7	73·5	— 0·6	62·5	54	2·8	0·12	— 0·33	3	10·6	80
Coolgardie	1012·2	— 0·3	110	53	95·6	64·1	79·9	+ 3·9	62·3	43	3·0	0·75	0·00	3	..	..
Brisbane	1016·6	+ 4·1	92	63	82·7	67·5	75·1	— 1·4	68·9	67	6·7	1·81	— 4·38	13	7·7	60
Hobart, Tasmania	1015·2	+ 1·7	90	45	72·5	54·5	63·5	+ 1·1	56·2	61	5·7	1·23	— 0·22	6	8·1	59
Wellington, N.Z.	1018·3	+ 2·5	77	47	66·2	53·0	59·6	— 2·9	57·5	74	5·7	1·65	— 1·49	5	8·5	62
Suva, Fiji	1007·1	— 0·6	91	69	87·0	75·6	81·3	+ 0·8	76·8	78	6·0	19·91	+ 9·78	19	7·3	57
Apia, Samoa	1007·3	— 1·1	88	74	84·7	75·8	80·2	+ 1·2	77·8	82	6·0	18·93	+ 3·22	22	4·5	36
Kingston, Jamaica	1014·8	— 0·5	88	64	84·0	67·1	75·5	— 1·0	66·0	89	4·2	0·68	+ 0·08	6	6·8	59
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1016·9	— 1·1	55	— 6	34·1	19·5	26·8	+ 5·1	21·9	68	8·2	2·28	— 0·30	18	2·9	28
Winnipeg	1014·2	— 7·6	43	—29	18·9	5·4	12·1	+12·7	..	..	7·0	1·53	+ 0·69	10	3·2	32
St. John, N.B.	1015·6	+ 1·5	43	— 8	30·2	11·6	20·9	+ 1·0	16·9	75	6·0	4·54	+ 0·64	14	4·0	38
Victoria, B.C.	1014·7	— 1·2	54	33	46·8	37·5	42·1	+ 1·8	39·9	83	7·4	5·17	+ 1·64	21	3·1	30

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

ERRATA—*Sierra Leone*, 1929. Pressure value at M.S.L and diff. from normal, January, *for* "1008·4, −2·4" *read* "1011 8, +1·0." Year *for* "1012·2, +0·8" *read* "1012·5, +1·1."
Lagos, 1929

Climatological Table for the British Empire, February, 1930.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1018·2	+ 2·2	51	29	42·6	35·1	38·9	− 1·2	35·1	83	8·1	0·58	− 0·96	5	1·7	18
Gibraltar	1018·0	− 2·0	69	40	60·6	46·0	53·3	− 2·6	45·7	82	4·0	6·52	+ 2·30	12	..	..
Malta	1014·6	− 2·1	64	45	58·2	50·0	54·1	− 1·2	49·6	78	6·2	5·19	+ 2·99	15	5·9	55
St. Helena	1012·1	+ 2·1	..	58	..	59·7	..	..	60·9	95	8·1	0·98	− 2·82	12	..	..
Sierra Leone	1012·0	+ 1·2	95	71	88·1	73·9	81·0	− 1·3	72·9	76	3·5	0·15	− 0·15	1	..	..
Lagos, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1010·2	+ 2·3	89	56	79·8	63·8	71·8	− 0·2	..	81	6·5	10·86	+ 0·21	15	..	..
Salisbury, Rhodesia	1008·9	+ 1·3	86	51	81·1	59·6	70·3	+ 1·5	61·7	61	4·3	1·43	− 5·97	8	8·8	69
Cape Town	1015·0	+ 1·6	93	50	80·6	60·3	70·5	+ 0·2	61·7	73	2·9	1·09	+ 0·51	5	..	..
Johannesburg	1013·0	+ 1·1	89	44	76·9	55·4	66·1	+ 0·7	57·1	68	4·6	3·97	− 1·25	13	9·2	71
Mauritius	1010·6	− 0·4	87	66	84·0	73·0	78·5	− 0·8	75·2	78	6·5	5·38	− 3·02	22	7·8	61
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calcutta, Alipore Obsy.	1014·5	+ 1·2	93	51	83·3	61·4	72·3	+ 1·3	61·0	81	2·3	0·77	− 0·33	1*	..	..
Bombay	1013·6	+ 0·9	94	59	85·5	66·3	75·9	+ 0·3	63·4	65	0·5	0·00	− 0·03	0*	..	..
Madras	1013·3	+ 0·4	91	63	85·4	70·0	77·7	0·0	72·7	83	3·8	2·21	+ 1·89	5*	..	..
Colombo, Ceylon	1012·2	+ 1·1	93	68	87·6	72·3	79·9	+ 0·2	74·6	70	3·7	1·97	− 0·10	7	9·9	83
Hongkong	1019·1	+ 0·4	78	47	65·0	56·5	60·7	+ 1·6	56·1	72	6·3	1·38	− 0·22	7	5·6	49
Sandakan	..	..	88	72	86·3	73·2	79·7	− 0·4	75·7	79	..	2·37	− 7·25	6	..	..
Sydney, N.S.W.	1016·9	+ 2·8	106	59	78·7	66·9	72·8	+ 1·5	68·2	69	5·5	0·61	− 3·63	8	8·4	63
Melbourne	1016·2	+ 1·7	103	51	82·5	59·4	70·9	+ 3·5	61·8	57	4·9	2·70	+ 0·98	8	7·4	55
Adelaide	1014·9	+ 0·6	112	52	92·8	66·2	79·5	+ 5·4	64·0	36	3·1	0·43	− 0·23	3	10·2	77
Perth, W. Australia	1013·8	+ 0·8	102	53	84·3	62·7	73·5	− 0·6	62·5	54	2·8	0·12	− 0·33	3	10·6	80
Coolgardie	1012·2	− 0·3	110	53	95·6	64·1	79·9	+ 3·9	62·3	43	3·0	0·75	0·00	3	..	..
Brisbane	1016·6	+ 4·1	92	63	82·7	67·5	75·1	− 1·4	68·9	67	6·7	1·81	− 4·38	13	7·7	60
Hobart, Tasmania	1015·2	+ 1·7	90	45	72·5	54·5	63·5	+ 1·1	56·2	61	5·7	1·23	− 0·22	6	8·1	59
Wellington, N.Z.	1018·3	+ 2·5	77	47	66·2	53·0	59·6	− 2·9	57·5	74	5·7	1·65	− 1·49	5	8·5	62
Suva, Fiji	1007·1	− 0·6	91	69	87·0	75·6	81·3	+ 0·8	76·8	78	6·0	19·91	+ 9·78	19	7·3	57
Apia, Samoa	1007·3	− 1·1	88	74	84·7	75·8	80·2	+ 1·2	77·8	82	6·0	18·93	+ 3·22	22	4·5	36
Kingston, Jamaica	1014·8	− 0·5	88	64	84·0	67·1	75·5	− 1·0	66·0	89	4·2	0·68	+ 0·08	6	6·8	59
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1016·9	− 1·1	55	− 6	34·1	19·5	26·8	+ 5·1	21·9	68	8·2	2·28	− 0·30	18	2·9	28
Winnipeg	1014·2	− 7·6	43	−29	18·9	5·4	12·1	+12·7	..	..	7·0	1·53	+ 0·69	10	3·2	32
St. John, N.B.	1015·6	+ 1·5	43	− 8	30·2	11·6	20·9	+ 1·0	16·9	75	6·0	4·54	+ 0·64	14	4·0	38
Victoria, B.C.	1014·7	− 1·2	54	33	46·8	37·5	42·1	+ 1·8	39·9	83	7·4	5·17	+ 1·64	21	3·1	30

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

ERRATA—*Sierra Leone*, 1929. Pressure value at M.S.L and diff. from normal, January, *for* "1008·4, −2·4" *read* "1011 8, +1·0." Year *for* "1012·2, +0·8" *read* "1012·5, +1·1."
Lagos, 1929. " " " " October, *for* "1009·0, −2·7" *read* "1010·6, −1·1." Year *for* "1011·4, 0·0" *read* "1011·5 +0·1."

M.O. 326.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 65
Sept., 1930
No. 776

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH; YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 15, DONEGALL SQUARE WEST, BELFAST; or through any Bookseller.

The Recent Heat and Thunderstorms

By C. K. M. DOUGLAS, B.A.

A sudden spell of hot weather set in towards the end of August, and came as a great surprise after six weeks of cool, unsettled weather, culminating in a widespread gale on August 21st. Last year hot weather also set in late in August, but it was less severe and its onset less sudden. Temperatures of 90°F. or slightly over were recorded at many places (*e.g.*, 92°F. at Cambridge on the 28th and at Tottenham and Norwich on the 29th 93°F. at Camden Square and 90°F. at Nottingham on the 29th). Over a large area the hot spell was the most intense and prolonged since July, 1923, and was the most outstanding late hot spell since early September, 1906. The most remarkable feature was the suddenness of the change. At Kew Observatory the maximum temperatures for the period August 24th to 27th were 68°F., 72°F., 84°F. and 88°F., while at Eskdalemuir the maximum was 64°F. on the 26th and 83°F. on the 27th. Such sudden rises of temperature can only be produced by the arrival of warm air, which travels with the wind at about 2,000 feet. The surface air movements are slower, but the sun very rapidly warms up the surface air when temperature is high up above. The warm air spread from southern France to southern England between the 25th and 26th and to Scotland on the 27th. On the 27th the temperature at 5,000 feet at Duxford (Cambridgeshire) was 71°F., the highest ever recorded in this country at that level. Over most of England the hot spell lasted for four days,

(90924) P.S.14/89 1,050 9/30 M. & S. *Gp.303*

but in Scotland and Wales it was very brief, and Ireland escaped entirely. The heat was confined to western Europe, and there were no really high temperatures east of long. 10°E., while beyond long. 15°E. conditions were quite cool.

Thunderstorms were widespread and severe. Some places in the north experienced more than one severe storm, and heavy hail occurred locally. The storms commenced in the west and north on the night of August 26th, associated with a front separating the hot air from cool Atlantic air of polar origin. The front was practically stationary throughout the 28th, on a line roughly from Cornwall to the Shetlands. A notable storm moved northward over east Scotland on the night of the 28th, lasting for five hours at Aberdeen, the front being off the east coast. Next day violent storms broke out over northern England and southern Scotland, and extended to the Midlands and eastern England during the night. Over England they were due to the eastward movement of the front, which took place without any pressure gradient across it. Throughout the hot spell there was a steep lapse rate of temperature above 7,000 feet, and plenty of moisture in the lower layers, favouring severe thunderstorms as soon as the front started off convectional movements. There is no evidence that diurnal heating produced any local afternoon storms. Such storms are rare in hot weather late in the summer.

The complete change in the weather was so unexpected that it is worth while to examine closely the factors leading up to it. The spell of cool, unsettled weather which set in about July 10th was general over nearly the whole of Europe. On the summit of Säntis, in the Alps (8,200 feet), the temperature was often several degrees below the freezing point, with heavy snowfalls. From August 18th onwards, however, the temperature on the Alps was much higher, and the temperature over southern Europe gradually worked up. On the 23rd there was a WSW. gale on Säntis, with a fairly high temperature, and for the next two days there was a strong WSW. wind over an E. wind on adjacent low ground. Since barometric pressure is high over warm air, this wind structure definitely indicated high upper air temperatures over the Mediterranean. The same feature gave cirrus movements of 100 m.p.h. from the W. over England on the 23rd and 24th, and only slightly lower velocities on 25th. Pilot-balloon observations in the Mediterranean area showed mainly westerly winds from the 22nd to the 24th and light variable winds afterwards, so that the warm air probably arrived from the west. Temperature over the Azores was unusually high from the 18th to the 23rd, with six reports of 81°F. from Horta and one of 82°F.; this figure equals the highest maximum ever reported from there during the period 1903 to 1926. The warm air reached the Azores from south of Bermuda. Temperature was high for a long period over the United States and the Bermuda area. Probably the hot spells in the United States and in England were not entirely disconnected, though the popular idea of a " heat wave " crossing the Atlantic is misleading.

In order that the warm air should advance from the Mediterranean to England, it was necessary that the pressure distribution should become radically different from that which had prevailed for six weeks previously. The required change took place between August 23rd and 26th when an anticyclone moved east-north-east from the Bay of Biscay, increased in intensity, and became almost stationary. Meanwhile a depression which was rapidly approaching west Ireland early on the 25th was deflected away to northwards. On that date there was a strong WSW. upper current over the anticyclone, which was thus a superficial system. The cirrus movement over England began to back that evening, and by the 27th it was strong southerly, showing that the anticyclone extended to cirrus levels, probably well into the stratosphere. By that time the " heat wave " was already established. This upward extension is typical of the life history of anticyclones, and also of cyclones. The anticyclones extending to the stratosphere are often called " warm " anticyclones, and they usually become stationary for a few days, though they often move again when they start to decay. It is almost certain that their development is due to the northward extension of tropical air at high levels, but it is not yet known exactly how this takes place, or how the upper and lower anticyclones become combined. It is thus not yet possible to predict when or where a moving anticyclone will become stationary. The problem is even more difficult than that of cyclones, for with these we have the warm sector to help us.

The hot spell was terminated by the development of a new anticyclone in the polar air off our north-west coasts, which produced a northerly wind over the British Isles, quite shallow at first but deeper later. This development of a new anticyclone in polar air and the simultaneous decay of the warm anticyclone was quite typical. Sometimes the new system can be regarded as part of the old one, and if we do this we naturally obtain life histories of anticyclones extending to weeks.

The problems of anticyclones and of cyclones are very closely analogous, and will probably be solved together. The fact that both systems extend upwards suggests that the conditions in the lower levels greatly influence those up above, by some process not yet understood, but the conditions existing up above must of course also be taken into account. When this fundamental problem has been solved, there will be a good prospect of giving definite predictions of such marked weather changes as those recently experienced.

The Drought in North America

During July and the first half of August, the drought which had been intermittently felt in the United States throughout the first half of 1930 became accentuated with serious consequences for farmers in the eastern half of the country, reaching the proportions of a national disaster. The drought does not appear to have been so marked in Canada, except in the southern part of Ontario and in Nova Scotia.

The progress of the drought week by week can be followed in great detail from the tables and descriptions in the invaluable *Weekly Weather and Crop Bulletin*, published by the U.S. Department of Agriculture, Weather Bureau. In addition the issue of the *Bulletin* for the week ending August 12th contains a general survey, a summary of which may be of interest. The drought began in December, 1929, when the rainfall was much below normal in the middle Atlantic area. Similar conditions continued during January, in which month, however, there was heavy rain in the interior valleys. In February the east was again dry, and in March and April the drought extended to the Ohio and middle Mississippi valleys, where large areas received less than half the normal amounts. In May the rainfall was less than half the normal between west Virginia and the Mississippi Valley, and the eastern States were also dry, but the remaining parts of the country received sufficient rain. In June the drought-stricken area extended to the lower Mississippi Valley, where very little rain fell throughout the month. July was exceptionally dry over almost the whole country east of the Rocky Mountains, only limited regions receiving as much as half the normal rainfall. From Maryland in the east to Missouri and Arkansas in the west, this was the driest July on record, the total being less than one-third of normal, while several places were entirely rainless. Over a still more extensive area, including Louisiana and Mississippi, June and July together received only about 40 per cent. of normal and were drier than in any preceding year.

The rainfall distribution in the various districts during the period of nine weeks from June 11th to August 12th is shown week by week in Table I, compiled from statistics for 165 stations published in the *Weekly Weather and Crop Bulletin*, for these weeks. The table gives the average district rainfall in inches and the percentage of normal, and brings out the severity of the drought in the Gulf States, the Missouri Valley, and especially the Ohio Valley. The Pacific coast was practically rainless throughout the whole period, but the summer rainfall in this district is normally very small.

The *Bulletin* for the week ending August 5th contains a map showing the rainfall of July, 1930, as a percentage of normal.

The amounts exceeded 100 per cent. only over the Rocky Mountain region in the west, and in a long broken belt extending the length of the Atlantic coast from Maine to South Carolina. The Mississippi Valley from St. Louis nearly to Vicksburg and part of the Red River valley received less than one tenth of normal. Conditions during the longer period June 11th to August 12th are shown in Fig. 1, a sketch map compiled from the 165 stations in the *Weekly Weather and Crop Bulletin.* Areas with rainfall above normal are shaded, those with less than 50 per cent. are stippled. The number of stations was insufficient to show the details of the distribution, and it is probable that the small shaded areas in the centre and east, which represent the occurrences of intense local thunderstorms should be more numerous but individually smaller. Nevertheless the map gives an interesting picture of the severity of the drought in the east during the two worst months. Its preparation was only made possible through the prompt issue of data by the U.S. Weather Bureau.

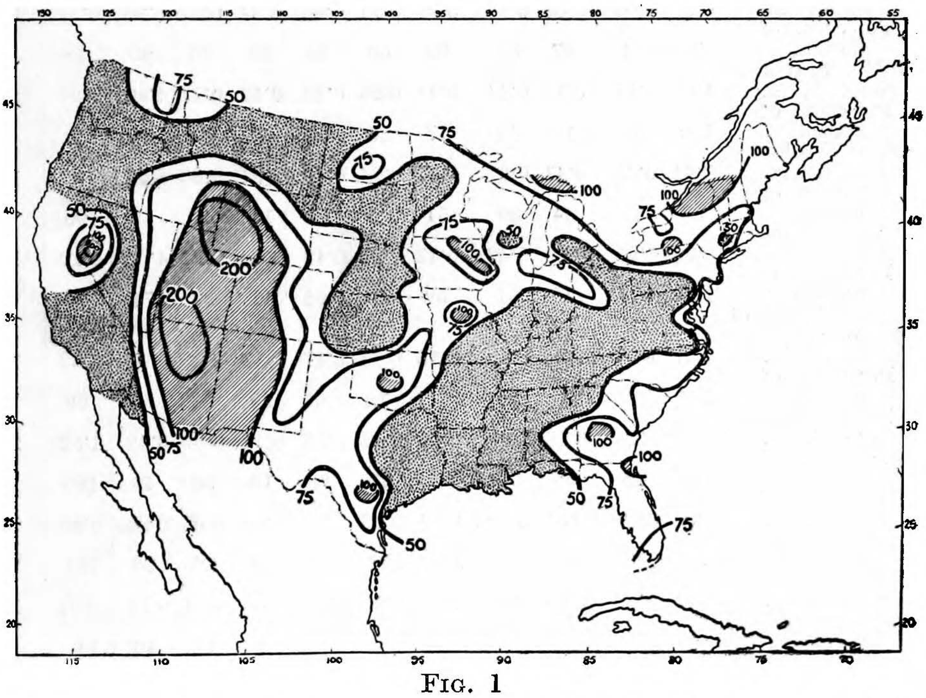


Fig. 1

This is not the place to go in detail into the causes of the drought, but some references to the prevailing types of pressure distribution associated with it may be of interest. The normal pressure distribution over the United States in July shows an anticyclone over the western North Atlantic extending across Florida, and an area of low pressure (about 1,005mb.) over south-eastern California and Arizona. In consequence of this distribution, a broad current of moist equatorial air sweeps northward from the Gulf of Mexico, over the whole of the States east of the Rocky Mountains. Over the northern part of the States the winds are variable, associated with the passage of a series of anticyclones and depressions eastward across the region of the Great Lakes. The Pacific States have a regime of north-westerly winds which need not be discussed here.

Table I shows that during the week July 9th to 15th the drought was most intense in the Upper Mississippi and Missouri Valleys, the latter receiving only seven per cent. of the normal fall. A glance at the *Daily Weather Maps* issued by the U.S. Weather Bureau shows that during that week the Atlantic anticyclone extended further west than usual, covering the south coast of the Gulf States as far as Texas. The low pressure over California remained, but the great current of equatorial air seems to have had a more westerly origin than usual, passing over the dry plateau of Mexico instead of the Gulf. Hence its humidity was low and it produced little or no rain. During this week the rainiest region was the Atlantic coast, where the south-westerly current met north-westerly winds associated with depres-

TABLE I

	WEEK ENDING									June 11 to Aug. 12	Aug. 13 to 19	No. of Stations
	June		July					August				
	17	24	1	8	15	22	29	5	12			
Atlantic Coast												
Amount, in.	0·56	1·05	0·66	0·83	0·95	0·71	0·96	0·37	0·27	6·36	0·77	32
Per cent. of normal	58	84	67	82	92	66	88	32	26	66	78	
Gulf States												
Amount, in.	1·35	0·44	0·19	0·44	0·41	0·25	0·49	0·42	0·41	4·40	0·96	27
Per cent. of normal	150	46	18	43	47	26	54	45	42	51	111	
Ohio Valley												
Amount, in.	0·61	0·32	0·41	0·37	0·47	0·04	0·40	0·01	0.33	2·96	0·89	14
Per cent. of normal	66	37	44	39	51	4	51	1	41	37	96	
Lake Region												
Amount, in.	0·93	0·95	0·86	0·43	0·42	0·28	0·49	0·08	0·22	4·66	0·12	18
Per cent. of normal	129	136	110	51	58	43	68	11	32	71	19	
Upper Mississippi Valley												
Amount, in.	1·57	1·03	1·20	0·48	0·13	0·14	0·47	0·19	0·26	5·47	0·62	14
Per cent. of normal	166	109	138	53	17	18	63	25	33	73	69	
Missouri Valley												
Amount, in.	1·07	0·44	0·49	0·30	0·05	0·42	0·25	0·11	0·36	3·49	1·32	21
Per cent. of normal	114	48	55	36	7	57	36	16	50	49	186	
Mountain Region												
Amount, in.	0·01	0·03	0·01	0·003	0·04	0·03	0·02	0·03	0·06	0·233	0·48	28
Per cent. of normal	30	114	28	12	164	122	69	124	225	96	191	
Pacific Coast												
Amount, in.	0·04	0·02	0·06	0·00	0·00	0·00	0·00	0·00	0·01	0·13	0·01	11
Per cent. of normal	19	11	47	0	0	0	0	0	17	16	11	

sions over the Gulf of St. Lawrence. In the following week the driest region (apart from the Pacific coast) was further east, in the Ohio valley, which received only four per cent. of normal. During the whole of this week, from July 16th to 22nd, the south-eastern States were under the influence of anticyclonic conditions resulting from an extension of the Atlantic high-pressure area towards the north-west. There was, however, a drift of air from the south, and a few places experienced heavy falls of rain during thunderstorms. These scattered falls brought up the average over the Gulf States to 26 per cent. During the week July 23rd to 29th, although the whole country received less than the normal rainfall, these sporadic thunderstorms became more frequent. Some places enjoyed rainfalls of more than an inch, or even two inches in a day, while at neighbouring places the drought remained unbroken. At Macon, Georgia, 2·00 inches fell on the 25th and 2·12 inches on the 26th, the total for the whole week reaching nearly five inches. On the other hand, Little Rock, Arkansas, received less than a quarter of an inch of rain between the beginning of June and the middle of August, and Dallas experienced two months without rain from the middle of June to mid-August.

The drought reached its greatest intensity over nearly the whole country during the week July 30th to August 5th, when the whole of the Ohio valley was practically rainless. Inspection of the weather maps shows that during this week the United States was crossed by a series of anticyclones moving slowly along irregular paths. Winds were light and variable, and there was no general influx of maritime air to produce favourable conditions for precipitation. Droughty conditions were relieved to some extent after August 12th, as will be seen from the column for August 13-19th in Table 1, but the drought persisted in the Lake region.

The effects of the continued scarcity of rain were accentuated in many districts by the high temperatures. Maxima of at least 108°F. were recorded at one or more of the stations included in the daily weather map on 25 days between June 28th and August 6th, but most of these occurred at Phœnix and Yuma in Arizona, at both of which temperatures of 114°F. were experienced. In the Central States 110°F. was recorded at Omaha, Nebraska, on August 4th, and 108°F. at stations in Indiana on July 29th, Missouri and Arkansas on July 29th and 30th, and Kansas on August 3rd to 5th. On July 29th and 30th conditions were anticyclonic, with light winds and clear skies favouring intense insolation; but the maxima of August 3rd to 5th were associated with light south-westerly winds apparently originating in the desert regions of Arizona and northern Mexico.

Official Publication

The following publication has recently been issued.

PROFESSIONAL NOTES—

No. 57. *The effect of variation in relative wind force on the readings of the wet- and dry-bulb thermometers in a portable screen on board ship.* By E. G. Bilham, B.Sc., and J. E. Belasco, B.Sc. (M.O. 273q).

The paper contains the results of trials carried out in four of H.M. Survey Ships, simultaneous readings from Assmann psychrometers being taken for comparison. Taking the Assmann readings as representing the true values, the following conclusions were reached :—

(1) Provided the readings are taken on the windward side of the ship, the temperature readings in the screen will agree to within 1°F. with the true value on more than 90 per cent of the occasions.

(2) With similar precautions the relative humidity determined from dry- and wet-bulb thermometers in the screen will be within 5 per cent of the true value on 95 per cent of occasions.

(3) Large discrepancies between screen and Assmann readings are not conspicuously associated with light winds. The results do not justify a recommendation to ignore readings taken in relative winds below force 3 on the Beaufort scale.

Correspondence

To the Editor, *The Meteorological Magazine*

Thunderstorm in Scotland, August 29th

Particulars of a very severe hailstorm last Friday morning, August 29th, may possibly be of interest to your readers. The storm burst about 11 a.m. at Peebles, but it only appears to have struck with its full force the eastern side of the town; windows on the north-west side of the house we were staying in were all broken, and the greenhouses smashed to bits. Apples, &c., were knocked down and any fruit remaining on the trees was cut or bruised by the hailstones. The Hydro Hotel had over 1,200 panes smashed, all on the west side.

The storm caught us on the hills, on our way to shoot grouse; thunder was incessant overhead, but appeared to be at an immense height; suddenly it became intensely dark, and a few hailstones, about the size of a pigeon egg began to fall slowly, so we went for shelter, but the storm burst just before we reached it. A terrific roar was heard in the distance just prior to the breaking of the storm. Hailstones of 5 inches in circumference and over then fell for 10 minutes in a mass, accompanied by a deluge of rain, and a wind of 50 m.p.h. or more, from the NW.; the thunder and lightning were incessant. The hailstones were very interesting; they were nearly all round, the shape of a soap tablet, but the centres were bulged out each side; a few were like coral in appearance, but these were probably due to several small stones binding together. The round ones had a "snow" centre, about ¼in. in diameter and the remainder of the "stone" was composed of very hard frozen ice. These "stones" remained on the ground for over five hours before dissolving, though the temperature on the hills after the storm was up to 70°F. These round ice stones were similar to those which fell at Peebles. The hills mentioned were about 3 miles north-east of Peebles, and the storm appears to have started at Peebles, and spent its fury in the open hills to the north-eastward, fortunately for everyone concerned.

We proceeded with the shoot after the storm, and 5½ brace of dead and wounded grouse were picked up, and also three rabbits. The keeper had a bad knock on his shoulder from a chunk of ice, but he recovered in a few moments, and got into shelter. A shepherd was hit twice, and the following day his arm looked as if it had been burnt, which possibly means he was struck by lightning. The storm appears to have followed a very narrow path, at a great speed, for about 5 miles.

ARTHUR VENABLES, Commander R.N., retd.

Onny Cottage, Bromfield, Ludlow. September 1st, 1930.

Thunderstorm, August 29th-30th, 1930

Before the severe thunderstorm on the above date the presence of instability at high levels was already indicated as early as August 27th at 04.30, when cumulus tops with false cirrus were visible above the west horizon; during the day alto-cumulus castellatus developed in the north-east between 16.00 and 18.00. August 28th, apart from early morning fog and some cirrus tufts to north-east at 12.00, was cloudless. Small hard convection cumulus first appeared at 14.00 on August 29th, but did not develop to any extent, and had disappeared by 17.00 at which hour there was considerable cirrus over the sky, dense in places.

At 19.00 well marked alto-cumulus castellatus was in evidence in the west and south-west, and cumulus tops were just showing above the southern horizon; an anvil, not well developed, was indicated in the north-west. Sheet lightning was first seen in the south-west at 19.45, and at 20.40 the rate of flash discharge averaged 20 per minute. Between 20.45 and 22.15 the flashes disclosed much false cirrus with alto-cumulus and very large towering cumulo-nimbus, separate storm centres being in evidence to south and west. Thunder was distant, and sheet lightning more frequent than fork. At 22.45 the rate of flash discharge had risen to 37 per minute, and the cloud sheet had become almost uniform. From a flat calm the wind rose in a sudden squall at 23.05, and heavy rain commenced at 23.09; at this hour the flash discharge was at the rate of 50 per minute, there was a subsequent increase to 63 per minute at 23.30 which had decreased to 56 per minute at 23.45. Between 23.30 and 24.00 thunder and lightning were almost incessant. Lightning continued visible in the north and north-west, and distant thunder was heard to about 04.00 on August 30th. All times are G.M.T.

The above rates of flash discharge are in excess of any I have personally recorded in south-east England during the past 25 years. On August 22nd, 1917, a flash rate of 50 per minute was registered, and during the great storm on July 9th-10th, 1923, the maximum flash rate per minute was 47. The latter storm was of a more severe character, the majority of the flashes being of the cloud-to-earth type, and the thunder more intense and of very prolonged duration. During the present storm cloud-to-cloud flashes predominated, and the thunder, though intense, was not of prolonged duration.

SPENCER RUSSELL.

Worcester Park, Surrey.

It may interest some of your readers to know that during the thunderstorm here on the night of Friday to Saturday, August 29th-30th, 1930, the number of distinct lightning flashes per minute at one time reached 44. The values I obtained looking towards the north-east at quite a small patch of sky were :—

Time (B.S.T.)	No. of flashes per min.	Time (B.S.T.)	No. of flashes per min.
0.35	44	0.51	36
0.40	40	0.57	37
0.43	27	1.00	32
0.47	24	1.05	22

J. E. BELASCO.

21, *Gunter Grove, Chelsea, S.W.10. Sept. 5th, 1930.*

Rare Cloud Form

On July 12th I observed a remarkable formation of cloud similar to that which I had observed at Hastings in 1922 and recorded in your magazine shortly afterwards* and noted as the " Noah's Ark," so termed by the Orkney fishermen, who will not proceed to sea if such is observed. On each of these occasions the days were brilliant with sunshine, and after each a gale was experienced, although locally here at Bristol it was not felt, but in the Bristol Channel it was in force.

The character of this July cloud was similar in shape, but the north end was more pointed than the south end but its boat form was the same, the whole reaching from ENE to WSW,

---

*See *Meteorological Magazine*, 60, 1925, p. 215.

nearly half of the sky; the north end on its east side had an exquisite feathery edge, and the filling being of the alto-cumulus and alto-stratus type, whilst the north side developed a number of cubic strata portions: parallel with this large body was one smaller, with pointed ends and a formation like the backbone of a large fish and the under filling of stratus cloud. The whole formation had drifted by us soon after sunset; the first was observed about 7h. S.T.

HENRY A. ROGERS.

31, Fernbank Road, Redland, Bristol.

Halo Phenomena in False Cirrus

On August 12th, at 12.25 p.m., there was a row of cumulo-nimbus heads along the western horizon, the altitude of the highest being about 17°. From this there rose a large mass of false cirrus reaching exactly to the zenith. Rain began at 12.42 and ceased at 12.58, at which instant the cumulo-nimbus had passed and false cirrus was again visible. A brilliant parhelion of the halo of 22° appeared immediately above the sun, and so did a part of an inverted inferior arc of contact to the same halo. The halo was invisible, but the brilliance of the parhelion was almost as great as that of the sun itself, veiled, as it was, by much false cirrus. The *Meteorological Magazine* contains record of an observation of a mock sun in false cirrus at Aberdeen on November 27th, 1920. These observations would indicate that, since false cirrus gives rise to the halo type of optical phenomena, it consists of ice crystals and is therefore similar to the " true " cirrus. Capt. C. J. P. Cave (*Nature*, February 6th, 1926) has given measurements made on January 24th, 1926, of a sheet of alto-cumulus at a height of 10,000-10,500ft. with cirrus below it, appearing darker and travelling faster. It would appear unnecessary to class false cirrus as a separate form of cloud. Sir Napier Shaw has suggested the use of the term " low cirrus." To-day, at 11.18 a.m., an inverted superior arc of contact to an invisible halo of 22° was observed.

S. E. ASHMORE.

Windwhistle Cottage, Grayshott, Hindhead, Surrey. August 17th, 1930.

Underground Water Level in the North Downs

The prediction made in July, 1929,* that the present year was likely to be one of low underground water level has not been fulfilled. Up to the end of September, 1929, scarcity of rainfall continued at Detling, but the succeeding four months entirely altered the outlook. From October, 1929, to January, 1930, inclusive, the rainfall amounted to 18·51in., and the number of rain-days to 93 out of a possible 123. The heavy

---

*See *Meteorological Magazine,* 64, 1929 p. 161.

rainfall, coupled with the persistence of the daily falls, caused the underground water level to rise quickly at the beginning of the present year.

The three hill wells reached a maximum level at the commencement of May; below the hill this was attained in March, being a month earlier in both cases than is normally experienced.

1930		Depth of Water	Diff. from Average (1911-29)	1930		Depth of Water	Diff. from Average (1911 29)
		ft. in.	ft. in.			ft. in.	ft. in.
May	Hucking	64 4	+3 5	Mar.	Detling (Croft)	27 1	+7 8
,,	Little Pett	55 3	+4 1				
,,	Stockbury	40 0	—0 8	,,	Detling (Naylor)	19 9	+6 8

At Detling (Croft) where plumbings are taken daily the water level fell to 5ft. 9in. on December 1st, 1929, and a maximum of 27ft. 10in. was reached on March 15th, 1930. Since the attainment of maximum water levels, both on and below the hill, the rate of depletion has been slow, and a heavy rainfall in May, 3·93in., retarded the fall still further.

SPENCER RUSSELL.

The Croft, Detling, Maidstone, Kent. July 23rd, 1930.

NOTES AND QUERIES

Halo into Circumzenithal Arc

Dr. F. J. W. Whipple has kindly sent us the following letters from M. Louis Besson, of the Observatory of Montsouris, Paris: "The perusal of the note entitled 'Halo into circumzenithal arc' in the *Meteorological Magazine* for October, 1929, has led me to consult the statistics of the Montsouris Observatory. I have limited my search to the period from January 1st, 1919.

Since that date we have observed :—

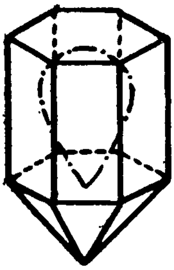
Circumzenithal arc without 46° halo	91 times
46° halo without circumzenithal arc	32 times
The two simultaneously or consecutively ...	11 times
and lastly, a short arc of undetermined curvature which we call summit of 46° halo ...	35 times

In the eleven cases in which the halo and the arc have both been seen :—

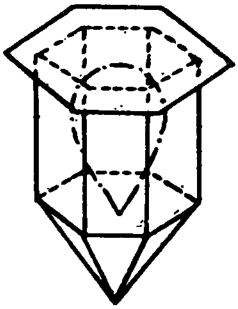
The arc succeeded the halo	3 times
The halo succeeded the arc	0 times
The halo has been preceded and followed by the arc	1 time
The two phenomena have been visible together, at least during part of the time	7 times

The following, in my opinion, is the reason why we sometimes see the halo, sometimes the arc:—

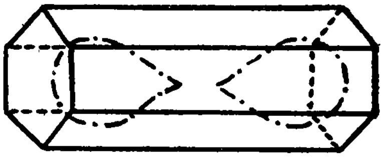
The fundamental form of prismatic ice is a hexagonal prism terminating at one end in a pyramid and enclosing a cavity. Nordenskjöld has compared these small bodies to bottles (form 1). The refraction of light in the dihedrons of 90° gives a phenomenon at 46° from the sun. If the dimensions of these bodies are almost the same in all directions, they have not any definite orientation in falling and the halo of 46° is seen. It may happen, however, that owing to the empty space inside, the pointed ends may be the heavier and the bodies have a certain tendency to stay vertical. The 46° halo is then reduced to the upper part (which is generally the case). In order that the circumzenithal arc should develop, the prisms must be orientated exactly vertical, which happens if they have in addition a projecting lamella forming a parachute (form 2). In a good proportion of cases the arcs, concave to the sun, that are seen at 46° from the sun, are not the halo, but supralateral arcs produced by prisms with horizontal axes. Form 1 tends to take this position when its length is greater than its transverse diameter, but the horizontal position is chiefly taken up by form 3, which results from the union of two prisms at their points.



1



2



3

These ice forms are not at all hypothetical; they have been described or photographed many times.

In Mr. Parker's observations, it seems that form 1 elongated may at first predominate, giving the lateral arcs of the large halo (see sketches of the supralateral arcs). There was probably at the same time a maximum of light at the summit of the 22° halo (see sketch of the upper tangent arc of 22°). A little later, form 1 shortened, and finally form 2 acquired the predominance whence the appearances of the lateral parts of the halo of 22°, the disappearance of its upper part, concentration of the light at the summit of the 46° halo, and finally the appearance of the circumzenithal arc marking doubtless the apogee of form 2."

In his reply to this Dr. Whipple remarked:—

"Personally I find it difficult to believe that the ice crystals can develop caps to serve as parachutes sufficiently rapidly to explain the transformation which I described in the *Meteorological Magazine*.

"Perhaps the rôle played by turbulence in producing such phenomena has not been considered enough. If a shower of crystals fell from a turbulent region to a calm one it might happen that crystals which were oscillating violently in the turbulent region would get steady when they reached the calmer air. The result would be a transformation of the halo."

M. Besson replied:—

"As a general rule halo phenomena other than the 22° and 46° circles appear rather suddenly, sometimes even very suddenly. I remember in particular a parhelic circle, the whole of which suddenly became visible. An unknown factor had entered into play at the same moment over a considerable area. Now experience shows that the formation of small crystals is very sudden in solutions. Why should it not be the same in the atmosphere?

"Your suggestion about the rôle of turbulence is certainly one to retain and examine. But I will first put a prejudicial question: Are there, in fact, any oscillations? I doubt it. A little lamella of cigarette paper of some tenths of a millimetre in diameter falls quite flat without any oscillations under ordinary pressure, and yet that is the form most subject to oscillations. Is it the same in rarefied air for bodies of the same dimensions or smaller? It would be necessary to make the experiment, but it appears probable to me. I suspect that the crystals are diverted from their normal orientation not by oscillations but by irregularities of form, either "congenital" or due either to evaporation or to a deposit of hoar frost.

Floods in Ceylon, May, 1930

Capt. A. J. Bamford has kindly sent us the following additional information about the floods in Ceylon, which were the subject of a brief reference in the *Meteorological Magazine* for June, page 128:—

"The days of heaviest rain were the 5th and 6th, when the centre of a depression was moving northward off the east coast, and on which the average rainfalls for the whole of the Kelani catchment were 5½in. and 7in. respectively. In most high Kelani floods in the past the bulk of the trouble has originated in a particular part of the catchment, where rainfall of the order of 15in. or more has occurred. In this case comparatively few stations recorded over 10in. in a day, but the striking feature was the universality of the heavy rain, not only over the whole of the catchment, but over a great deal of the rest of the island.

As early as the 7th, *i.e.*, after the rainfall figures of the 6th came in, I was able to say with melancholy confidence that we were in for a 10ft. flood, which, owing to lack of data from previous floods, is as high as my rainfall river height coefficients go. As a matter of fact the maximum height as recorded at the standard (Nagalagan St.) gauge was 11ft. 1in. at about 1 a.m. on the 10th, which puts the crest about 1½in. above that in 1913. Your correspondent's excess of 3ft. may, of course, have occurred in a cul-de-sac. His reference to the 8th as the crucial day is probably due to this being the day on which one of the protecting embankments burst. As a matter of fact, the rainfall on that day was not so heavy, though quite bad enough to add to the difficulties of relief work and bund reinforcement. On the 9th, with the centre of the storm over southern India, it got in a further attack on us from the west, and was responsible for rain of the order of 4in. on that day."

The Development of Buys Ballot's Law

The name of Buys Ballot is to be found in almost every text book of meteorology and his law of the relation of wind direction and pressure distribution is taught in many schools which nowadays include elementary meteorology in their curriculum. It may therefore be of some interest to trace briefly the formulation of this law. Professor Buys Ballot, Director of the Dutch Meteorological Institute and Professor of Physics at Utrecht was amongst the pioneers in the use of synoptic meteorology for the issue of forecasts and storm warnings. In dealing with observations of pressure and temperature he made use of deviations from average values and in a paper* presented to the Paris Academy of Sciences in 1857 he discussed the results obtained from observations at three stations in Holland. After showing that strong winds are indicated by large differences between the deviations, he proceeded to explain that if pressure was higher at Helder than at Maastricht (*i.e.*, higher in the north than in the south), then the wind was from the east while if pressure was higher at Maastricht the wind was from west or north-west. In the *Jaarboek of the Meteorological Institute of the Netherlands* for the same year (published in 1858), p. 347, this conclusion is stated in more general terms. Translated into English it reads : " great barometric differences, within the limits of our country, are followed by stronger winds, and the wind is in general perpendicular, or nearly so, to the direction of the greatest barometric slope in such a way that a decrease of pressure from North to South is followed by an East wind, and a decrease from South to North by a West wind." In 1860 he published a paper entitled " Eenige Regelen voor aanstaande weersveranderingen in Nederland " (Some rules for approaching changes in the weather in the Netherlands), in which the law appears in its well-known form (p. 90). " Thus the rule for wind direction is this: if one places oneself in the direction of the wind with one's back to the place from which it is coming, then one has the lowest place (*i.e.*, pressure) on the left-hand just as in the case of hurricanes." These storms had long been known to have a whirling motion and the distinction between the anti-clockwise rotation in the northern hemisphere and the clockwise rotation in the southern hemisphere had been expounded by Dove in 1828.

---

* Note sur le rapport de l'intensité et de la direction du vent avec les écarts simultanés du baromètre. *Paris, C.-R. Acad. Sci.* 45, 1857, pp.765-8.

Reviews

Wind Pressure on Buildings. Experimental Researches (First Series). By J. O. V. Irminger and Chr. Nokkentved, translated from the Danish by A. C. Jarvis and R. Halfdan-Nielsen. Size $10\frac{1}{4} \times 7$, pp. 88+47 diagrams. Copenhagen, 1930. Price 10 kr.

The wind pressure to which an engineering structure will be submitted is a matter of fundamental importance to engineers, who, in the absence of accurate knowledge on the subject, have to work to a high factor of safety in order to avoid risk of disaster. A single occurrence like the collapse of the Tay Bridge in 1879 in a gale may lead to the expenditure of hundreds of thousands of pounds in providing increased strength on future structures which, if the facts were fully known, would be found to be unnecessary. The importance of research into this subject is fully recognised. Two methods of inquiry are open: (1) experiments on models in a wind tunnel, (2) measurements made on actual buildings. The authors of the present paper hold that the best method of attack is to conduct a comprehensive series of model experiments and then with the knowledge so gained to proceed to full-scale measurements in the open. If time were of no object, there would be nothing to be said against this programme, but in view of the urgency of the problem it would seem better, if possible, to conduct the model and full-scale experiments simultaneously, regarding each as supplementary to the other in order to obtain practical answers to the questions which are so urgently confronting engineers.

For the model experiments described in the paper, the authors used a wind tunnel of about one square foot section in which were placed model spheres, cubes, prisms and buildings. The pressure at different points on the surface of each was then determined by the following ingenious method:—

A series of holes 1mm. in diameter was bored over the surface of the model, which was, in every case, hollow, the inside being connected to a manometer. All the holes except one being covered with adhesive tape, the pressure in the position of the one hole was then read off. The other side of the manometer was connected to a static head.

The results obtained are set out fully in diagrams, in some cases tables being added. The authors call attention to a point which may easily be over-looked, *i.e.*, that in calculating the stress on a structure, it is necessary to take account of the internal pressure as well as the external. To determine the value of the internal pressure, they left silk threads through the holes in the models before covering the holes with adhesive tape, thus producing a model building with permeable walls. Actually it was found that all the holes could equally well be left open, the same result being obtained. These measurements show that in a wind of 25 metres per second, the internal pressure in a building may differ by as much as 3mm. of mercury from the static pressure in the surrounding air, and the importance of this fact with regard to obtaining accurate readings of barometric pressure in meteorological work is pointed out.

The intention of the authors being to confine their work to model experiments, it would be unreasonable to expect to find much reference to actual wind conditions and this side of the subject is treated in one chapter of five pages. Open-scale anemograph records are given to show the rapid changes of speed and direction of an ordinary wind and after reference to the data available, the conclusion is reached that in Europe a speed of 40 metres per second may be laid down as one which will practically never be exceeded.

The authors appear to write with considerable understanding of the subject and the frequent references to papers by other workers throughout the book show a very wide study. Among well-known English names to which reference is given may be mentioned Shaw, Dines, Cave and Taylor among meteorologists, and Sir John Wolfe Barry, Sir Benjamin Baker, Sir Ernest Stanton and Osborne Reynolds among engineers.

Tipos de distribución isobárica y de tiempo en el Golfo de Vizcaya. I. Introducción y generalidades. By the Director of the Observatory, M. Doporto, Trabajos del Observatorio de Igueldo (San Sebastian). Publ. 4. Size $8\frac{3}{4} \times 6\frac{1}{4}$in., pp. 40, 16 diagrams, 1 pl. San Sebastian, 1929.

The northern coast of Spain offers little shelter from northwesterly and northerly winds; gales and a variety of line-squall, known locally as the " galerna " have at times brought disaster to the fishing fleets, so that " local forecasting " for that region is of great practical importance. For some years now the Observatory on Monte Igueldo at San Sebastian has been doing valuable work in forecasting conditions in the Bay of Biscay, and the present " Introduction " is stated by the author to be based on five years' study of synoptic data and over two years' work in actual forecasting for the region. A short summary of previous work on weather types is given, followed by a description, with diagrams, of 12 isobaric types and brief notes of the weather usually associated with each type. The real test of a study of this kind is, of course, its usefulness in practice, but to the general reader the descriptions of types seem likely to be of considerable help in understanding the meteorology of northern Spain. Most of the studies of weather types date from before the rise of the polar-front theory, and Señor Doporto may be regarded as one of the pioneers in combining the Norwegian methods with the older methods of "types." A study of weather types on these lines for other parts of Europe would be of much service to the forecaster. An example of the local daily weather report is given showing the 7h. chart with "fronts" in the conventional markings; there are also spaces for a local forecast and any gale warning transmitted to the navigators' associations.

The author concludes with a useful note on the relation between state of sea and wind force and direction. He intends in future studies to extend the application of the Bjerknes methods to the individual weather types, and we look forward with much interest to the publication of the continuation of this work.

S. T. A. MIRRLEES.

Books Received

Annali dell'Ufficio Centrale Meteorologico e Geodinamico Italiano. Serie Seconda. Vol. XXIII. Parte II, 1901. Osservazioni degli Osservatorii Meteorici, Rome, 1929.

Revista de Meteorologia y Aerologia. Vol. I. Nos. 1-6, Dec., 1929 to May, 1930. Tacubaya D.F. Mexico, 1930.

Royal Alfred Observatory, Mauritius; Annual Report, 1928, and Results of magnetical and meteorological observations for January to June, 1929. Port Louis, 1929.

The climatic factor in man's physical environment. By Prof. R. de C. Ward (Scientific Monthly, XXX, 1930, pp. 170-83).

Meteorology in Mysore for 1928, being the results of observations at Bangalore, Mysore, Hassan and Chitaldrug. Thirty-sixth Annual Report, Bangalore, 1929.

Obituary

Professor Herbert Hall Turner.—We regret to learn of the death of Professor Turner on August 20th, at Stockholm, where he was attending a meeting of the International Union of Geodesy and Geophysics. Though primarily an astronomer and seismologist, he was well known to many meteorologists and served for a time on the Council of the Royal Meteorological Society. Prof. Turner was born at Leeds in 1861, and educated at Leeds Modern School, Clifton College and Trinity College, Cambridge. He displayed a genius for mathematics and graduated as second wrangler in 1882. In 1884 he became chief assistant at the Royal Observatory, Greenwich, leaving in 1893 to become Savilian Professor of Astronomy and Director of the University

Observatory at Oxford. He played a very large part in forwarding the international plan for mapping the heavens; among his other astronomical work may be mentioned his analysis of the periodicity of sunspots and his theory of the formation of sunspots by a swarm of meteorites derived from the Leonids.

Prof. Turner was elected a Fellow of the Royal Society in 1896, and from 1913 to 1922 he was one of the general Secretaries of the British Association. In 1913 also, after the death of Prof. Milne, he took charge of the latter's seismological bureau at Shide. A few years later the bureau was removed to Oxford under Prof. Turner's direction as President of the Seismological Committee of the British Association. His main interest in seismology lay in the investigation of periodicities, a subject which gave his mathematical bent full play in the improvement of methods of harmonic analysis, where he was one of the first to insist on the use of exact methods. In 1913 he published "Tables for facilitating the use of harmonic analysis"; he also investigated the long-period terms in the growth of the "Big Trees" of California, and developed a theory of "discontinuities" interrupting the regular periodic course of meteorological phenomena. His three papers on the latter subject in the *Quarterly Journals of the Royal Meteorological Society* for 1915 to 1917 were at the time the subject of much discussion. It was a great loss to the Society, on the personal as well as on the scientific side, that his numerous other activities prevented him from giving more time to meteorology.

News in Brief

Following the recent successful trans-Atlantic flight from east to west of the French airmen Costes and Bellonte, it is interesting to note that in addition to decorations bestowed on the pilots by the French Government, M. André Viaut of the forecast division of the Office National Météorologique, Paris, has been made Chevalier Légion d'Honneur in recognition of his work in connexion with the flight.

Corrigendum

August, 1930, page 164, footnote *for* "*Edinburgh Proc. R. Soc.*" *read* "*Edinburgh Trans. R. Soc.*"

The Weather of August, 1930

The first three weeks of the month were unsettled and generally rather cool and wet. For the first seven days heavy local rains or thunderstorms, due to a complex depression over the British Isles, were of almost daily occurrence, the largest falls in 24 hours being 1·89in. at Campsea Ashe, Suffolk on the 3rd and

2·60in. at Chewton Mendip, Somerset on the 6th; the temperature was considerably below the average, many places having maxima of 55-60°F. and minima below 45°F. The weather continued generally unsettled, although on the 10th and 11th the south-east of England had several maximum temperatures over 70°F.; on the 14th strong squally winds and local gales occurred in the rear of a deep depression which crossed northern Scotland. After this a temporary improvement set in and on the 16th good sunshine records were obtained, Harrogate having 14·3 hours of bright sunshine and Ross-on-Wye 13·9 hours. After a further period of unsettled weather with local thunderstorms, a vigorous secondary depression caused gales and heavy rain on the 20th and 21st. Several stations recorded over 2in. on the 20th and at Llyn Fawr Reservoir, Glamorgan, 3·51in. fell; at Borrowdale, Cumberland, 2·97in. fell in the 20th and 3·37in. on the 21st. During the last week of the month a great change took place, southerly winds bringing warm air from the western Mediterranean and giving rise to high temperatures. On the 27th maximum temperatures of over 80°F. were recorded inland over an area extending from Edinburgh and Dumfries to the south coast. For three consecutive days (27th-29th) temperatures rose above 90°F. in parts of London and on the 28th and 29th temperatures over 90°F. were recorded in other parts of England (see p. 177). The minimum temperature of 67°F. at Kew Observatory on the 30th is a record for the last ten days of August. Severe thunderstorms, accompanied by hail occurred in Scotland and northern England on the 28th and 29th (see pp. 178 and 184) and thunderstorms were experienced over a wide area in the night of the 29th-30th (see pp. 178 and 185).

The distribution of bright sunshine was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs).
Lerwick	136	+ 5	Liverpool	204	+18
Aberdeen	154	+ 4	Ross-on-Wye	196	+22
Dublin	133	— 29	Falmouth	184	—27
Birr Castle	99	— 43	Gorleston	220	+14
Valentia	106	— 49	Kew	221	+34

Pressure was below normal over the British Isles, about normal over Sweden and was above normal over southern and central Europe and over an area extending from Iceland to Spitsbergen, the greatest excess being 5·9mb. at Spitsbergen. Temperature was above normal at Spitsbergen, London, Sweden and in Portugal, and was below normal in Switzerland. Rainfall was above normal in Spitsbergen, northern Europe and Switzerland; in Sweden it was generally about normal, but only half the normal in southern Scania and double the normal in eastern Gothaland. Unusually big falls in a single day were rather common in southern Sweden.

Severe storms occurred over many parts of France on the 3rd and again on the 6th, doing much damage to the vineyards and the harvest and causing floods near Chambery. In several of the northern, central and Black Soil districts of Russia heavy rain during the early part of the month retarded the harvest. Heavy rainstorms were experienced near Innsbruck about the 13th. A thunderstorm accompanied by a whirlwind swept over Naples on the morning of the 14th and several persons were injured. At Lisbon a shade temperature of about 100°F. was recorded on the 15th. Rain fell in Berlin on most days during the first part of the month. During the greater part of the month cool weather was experienced generally over Europe but about the 25th there was a sudden rise in temperature over the whole of the central and southern regions, maximum temperatures exceeding 100°F. in Spain and reaching 93°F. at Paris and 86°F. at Berlin. Several deaths due to the heat were reported. A violent thunderstorm occurred over Paris on the 30th.

Severe and widespread floods occurred in Hondo (Japan) during the first days of the month following two typhoons off the northern coast. The rains were almost continuous for three days. Great heat occurred in 'Iraq about the 9th when a temperature of over 120°F. was reported. Floods occurred in the region between Tientsin and Mukden during the week ending the 11th. A typhoon swept across south-eastern Japan and the Sea of Japan on the 12th causing considerable damage. The Sind floods reported in last month's magazine continued throughout August and also extended over a wider area. Altogether 500 sq. miles on the west bank of the Indus were submerged. By the 25th the northern floods were believed to have reached their farthest limit and the southern floods were beginning to subside.

The special message from Brazil states that the rainfall in the northern and central regions was scanty with averages 1·54in. and 0·6in. below normal respectively, while in the southern regions it was plentiful. Seven anticyclones passed across the country. There were general and frequent frosts in the three southern states. Important crops suffered from the continued lack of rain, especially coffee, cotton, tobacco and sugar cane. At Rio de Janeiro pressure was 1·3mb. below normal and temperature 1·3°F. above normal.

Rainfall, August, 1930.—General Distribution

England and Wales	124	per cent of the average 1881-1915.
Scotland	167	
Ireland	153	
British Isles	142	

Rainfall: August, 1930: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square..........	2·94	133	*Leics* .	Belvoir Castle...........	2·07	79
Sur .	Reigate, Alvington.....	3·37	137	*Rut* :	Ridlington................	2·80	...
Kent .	Tenterden, Ashenden...	3·69	161	*Linc* .	Boston, Skirbeck........	2·73	114
,, .	Folkestone, Boro. San..	2·60	...	,, .	Cranwell Aerodrome...	2·19	81
,, .	Margate, Cliftonville...	3·37	175	,, .	Skegness, Marine Gdns	2·26	93
,, .	Sevenoaks, Speldhurst	3·66	...	,, .	Louth, Westgate........	2·31	82
Sus .	Patching Farm.........	3·86	153	,, .	Brigg, Wrawby St.....	3·66	...
,, .	Brighton, Old Steyne..	3·83	176	*Notts* .	Worksop, Hodsock.....	2·91	119
,, .	Heathfield, Barklye....	4·31	160	*Derby* .	Derby, L. M. & S. Rly.	2.26	87
Hants .	Ventnor, Roy. Nat. Hos.	3·01	151	,, .	Buxton, Devon Hos....	5·67	129
,, .	Fordingbridge, Oaklnds	4·81	183	*Ches* .	Runcorn, Weston Pt...	4·36	121
,, .	Ovington Rectory.......	3·28	121	,, .	Nantwich, Dorfold Hall	3·26	...
,, .	Sherborne St. John.....	2·40	99	*Lancs* .	Manchester, Whit. Pk.	4·51	131
Berks .	Wellington College.....	...	...	,, .	Stonyhurst College.....	7·43	147
,, .	Newbury, Greenham...	2·92	111	,, .	Southport, Hesketh Pk	5·93	171
Herts .	Welwyn Garden City...	3·16	...	,, .	Lancaster, Strathspey	6·23	...
Bucks .	High Wycombe..........	3·53	152	*Yorks* .	Wath-upon-Dearne.....	2·23	93
Oxf . .	Oxford, Mag. College..	1·85	82	,, .	Bradford, Lister Pk....	4·20	155
Nor .	Pitsford, Sedgebrook...	2·39	99	,, .	Oughtershaw Hall......	8·70	...
,, .	Oundle....................	1·70	...	,, .	Wetherby, Ribston H.	3·16	116
Beds .	Woburn, Crawley Mill	2·44	106	,, .	Hull, Pearson Park.....	2·97	102
Cam .	Cambridge, Bot. Gdns.	1·55	66	,, .	Holme-on-Spalding.....	4·47	...
Essex .	Chelmsford, County Lab	2·00	92	,, .	West Witton, Ivy Ho.	5·51	...
,, .	Lexden Hill House....	1·94	...	,, .	Felixkirk, Mt. St. John	2·90	102
Suff .	Hawkedon Rectory.....	2·64	102	,, .	Pickering, Hungate....	2·93	...
,, .	Haughley House........	3·35	...	,, .	Scarborough.............	3·07	110
Norf .	Norwich, Eaton.........	2·39	101	,, .	Middlesbrough..........	3·38	123
,, .	Wells, Holkham Hall	1·60	67	,, .	Baldersdale, Hury Res.	5·43	...
,, .	Little Dunham..........	3·55	132	*Durh* .	Ushaw College..........	5·33	183
Wilts .	Devizes, Highclere......	3·30	114	*Nor* .	Newcastle, Town Moor	5·02	172
,, .	Bishops Cannings.......	2·96	95	,, .	Bellingham, Highgreen	4·23	...
Dor .	Evershot, Melbury Ho.	4·03	128	,, .	Lilburn Tower Gdns....	4·19	...
,, .	Creech Grange..........	3·42	...	*Cumb* .	Geltsdale.................	6·69	...
,, .	Shaftesbury, Abbey Ho.	2·46	84	,, .	Carlisle, Scaleby Hall	7·01	171
Devon .	Plymouth, The Hoe....	3·87	125	,, .	Borrowdale, Seathwaite	15·15	131
,, .	Polapit Tamar...........	4·08	128	,, .	Borrowdale, Rosthwaite	15·74	...
,, .	Ashburton, Druid Ho.	5·76	154	,, .	Keswick, High Hill.....	8·56	...
,, .	Cullompton......	4·12	135	*Glam* .	Cardiff, Ely P. Stn.....	5·88	136
,, .	Sidmouth, Sidmount...	3·12	111	,, .	Treherbert. Tynywaun	10·11	...
,, .	Filleigh, Castle Hill....	5·40	...	*Carm* .	Carmarthen Friary.....	4·86	105
,, .	Barnstaple.N.Dev.Ath.	4·07	123	,, .	Llanwrda.................	5·37	98
Corn .	Redruth, Trewirgie.....	6·23	182	*Pemb* .	Haverfordwest, School	4·84	116
,, .	Penzance, Morrab Gdn.	4·78	151	*Card* .	Aberystwyth............	4·67	...
,, .	St. Austell, Trevarna...	6·76	187	,, .	Cardigan, County Sch.	3·17	...
Soms .	Chewton Mendip........	7·22	161	*Brec* .	Crickhowell, Talymaes	5·90	...
,, .	Long Ashton............	5·17	...	*Rad* .	Birm W. W. Tyrmynydd	7·09	131
,, .	Street, Millfield........	3·17	...	*Mont* .	Lake Vyrnwy...........	5·09	98
Glos. .	Cirencester, Gwynfa....	...	...	*Denb* .	Llangynhafal............	3·70	...
Here .	Ross, Birchlea...........	3·45	135	*Mer* .	Dolgelly, Bryntirion...	8·92	158
,, .	Ledbury, Underdown..	2·88	110	*Carn* .	Llandudno................	3·20	106
Salop .	Church Stretton.........	2·85	88	,, .	Snowdon, L. Llydaw 9	17·56	...
,, .	Shifnal, Hatton Grange	2·29	81	*Ang* .	Holyhead, Salt Island	4·81	151
Worc .	Ombersley, Holt Lock	2·68	100	,, .	Lligwy.....................	5·20	...
,, .	Blockley..................	2·63	..	*Isle of Man*			
War .	Farnborough.............	1·98	73		Douglas, Boro' Cem....	6·24	164
,, .	Birminghm, Edgbaston	3·17	117	*Guernsey*			
Leics .	Thornton Reservoir....	2·74	98		St. Peter P't. Grange Rd.	3·42	145

Erratum: Birm. W.W., Tyrmynydd, July, for 6·88/167 read 6·38/155.

Rainfall: August, 1930: Scotland and Ireland

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Wigt.	Pt. William, Monreith	5·00	...	*Suth* .	Loch More, Achfary	9·64	165
,, .	New Luce School	...	...	*Caith* .	Wick	5·57	202
Kirk .	Carsphairn, Shiel	10·86	...	*Ork* .	Pomona, Deerness	4·17	145
Dumf.	Dumfries, Crichton, R.I	7·07	186	*Shet* .	Lerwick	4·36	145
,, .	Eskdalemuir Obs.	8·08	157	*Cork* .	Caheragh Rectory	5·90	...
Roxb .	Branxholm	6·22	193	,, .	Dunmanway Rectory	5·56	118
Selk .	Ettrick Manse	8·98	...	,, .	Ballinacurra	4·69	126
Peeb .	West Linton	5·74	...	,, .	Glanmire, Lota Lo.	5·65	155
Berk .	Marchmont House	4·70	142	*Kerry*.	Valentia Obsy.	7·96	166
Hadd.	North Berwick Res.	4·70	149	,, .	Gearahameen	8·80	...
Midl .	Edinburgh, Roy. Obs.	5·17	167	,, .	Killarney Asylum	5·48	124
Ayr .	Kilmarnock, Agric. C.	5·44	139	,, .	Darrynane Abbey	7·85	181
,, .	Girvan, Pinmore	6·62	149	*Wat* .	Waterford, Brook Lo.	4·29	112
Renf .	Glasgow, Queen's Pk.	5·37	152	*Tip* .	Nenagh, Cas. Lough	5·41	137
,, .	Greenock, Prospect H.	6·82	125	,, .	Roscrea, Timoney Park	5·65	...
Bute .	Rothesay, Ardencraig.	8·09	166	,, .	Cashel, Ballinamona	6·26	176
,, .	Dougarie Lodge	5·81	...	*Lim* .	Foynes, Coolnanes	5·07	131
Arg .	Ardgour House	10·78	...	, .	Castleconnel Rec.	5·69	...
,, .	Manse of Glenorchy	8·74	...	*Clare* .	Inagh, Mount Callan	7·22	...
,, .	Oban	8·06	...	,, .	Broadford, Hurdlest'n.	6·21	...
,, .	Poltalloch	8·32	170	*Wexf*.	Gorey, Courtown Ho.	4·50	135
,, .	Inveraray Castle	12·44	189	*Kilk* .	Kilkenny Castle	6·06	174
,, .	Islay, Eallabus	8·93	205	*Wic* .	Rathnew, Clonmannon	5·17	...
,, .	Mull, Benmore	20·00	...	*Carl* .	Hacketstown Rectory	7·95	196
,, .	Tiree	...	...	*Leix* .	Blandsfort House	6·42	162
Kinr .	Loch Leven Sluice	6·45	168	,, .	Mountmellick	5.73	...
Perth .	Loch Dhu	8·95	133	*Off'ly* .	Birr Castle	5·71	150
,, .	Balquhidder, Stronvar	5·66	...	*Kild'r*.	Monasterevin	5·26	...
,, .	Crieff, Strathearn Hyd.	5·94	141	*Dubl* .	Dublin, FitzWm. Sq.	5·04	166
,, .	Blair Castle Gardens	5·79	171	,, .	Balbriggan, Ardgillan.	4·64	136
,, .	Glen Bruar, Bruar Ldg.	6·51	...	*Me'th* .	Beauparc, St. Cloud	6·18	...
Angus.	Kettins School.	6·13	185	,, .	Kells, Headfort	6·08	147
,, .	Dundee, E. Necropolis	6·09	180	*W.M* .	Moate, Coolatore	5·69	...
,, .	Pearsie House	7·21	...	,, .	Mullingar, Belvedere	6·47	155
,, .	Montrose, Sunnyside	5·81	208	*Long* .	Castle Forbes Gdns	5·76	141
Aber .	Braemar, Bank	5·38	158	*Gal* .	Ballynahinch Castle	9·62	175
,, .	Logie Coldstone Sch.	5·73	181	,, .	Galway, Grammar Sch.	4·59	...
,, .	Aberdeen, King's Coll.	5·95	217	*Mayo* .	Mallaranny	9·85	...
,, .	Fyvie Castle	7·17	...	,, .	Westport House	5·78	143
Moray.	Gordon Castle	5·11	161	,, .	Delphi Lodge	11·08	...
,, .	Grantown-on-Spey	4·68	146	*Sligo* .	Markree Obsy	7·29	167
Nairn.	Nairn, Delnies	5·20	216	*Cav'n* .	Belturbet, Cloverhill	5·28	142
Inv .	Kingussie, The Birches	3·17	...	*Ferm* .	Enniskillen, Portora	...	...
,, .	Loch Quoich, Loan	12·35	...	*Arm* .	Armagh Obsy	5·85	162
,, .	Glenquoich	11·87	140	*Down* .	Fofanny Reservoir	10·40	...
,, .	Inverness, Culduthel R.	4·07	...	,, .	Seaforde	6·57	175
,, .	Arisaig, Faire-na-Squir	7·49	...	,, .	Donaghadee, C. Stn	5·12	154
,, .	Fort William	7·95	...	,, .	Banbridge, Milltown	6·05	...
,, .	Skye, Dunvegan	7·32	...	*Antr* .	Belfast, Cavehill Rd	6·52	...
R & C.	Alness, Ardross Cas	7·05	239	,, .	Glenarm Castle	8·17	...
,, .	Ullapool	7·08	...	,, .	Ballymena, Harryville	7·69	180
,, .	Torridon, Bendamph	10·14	154	*Lon* .	Londonderry, Creggan	8·12	175
, .	Achnashellach	9·80	...	*Tyr* .	Donaghmore	7·87	...
,, .	Stornoway	4·80	121	,, .	Omagh, Edenfel	6·90	162
Suth .	Lairg	6·68	...	*Don* .	Malin Head	5·37	...
,, .	Tongue	5·86	183	,, .	Dunfanaghy	4·85	...
,, .	Melvich	...	...	,, .	Killybegs, Rockmount.	7·07	126

Climatological Table for the British Empire, March, 1930.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb							
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1011·3	— 2·1	58	26	49·8	36·7	43·3	+ 0·9	37·3	87	7·5	1·48	— 0·21	13	3·9	33
Gibraltar	1016·9	— 0·1	73	44	66·5	50·5	58·5	+ 1·0	50·8	83	4·8	1·77	— 3·02	8	..	..
Malta	1015·1	+ 0·3	72	47	62·6	52·7	57·7	+ 0·6	53·1	79	6·2	0·31	— 1·17	3	8·3	70
St. Helena	1011·6	+ 2·1	..	59	..	60·6	..	..	61·7	91	7·7	3·31	— 1·63	15	..	..
Sierra Leone	1012·5	+ 1·8	90	69	85·9	72·3	79·1	— 3·3	73·1	77	3·9	0·92	— 0·24	2	..	..
Lagos, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1009·6	— 0·1	85	61	77·8	64·4	71·1	— 0·2	..	84	7·6	5·74	— 3·34	18	..	..
Salisbury, Rhodesia	1010·2	— 0·1	85	53	76·1	58·6	67·3	— 0·9	60·8	70	7·1	3·75	— 0·75	11	5·3	43
Cape Town	1015·1	+ 0·6	104	51	80·2	59·8	70·0	+ 1·9	60·7	75	4·2	0·47	— 0·41	8	..	..
Johannesburg	1015·1	+ 0·1	84	43	73·0	51·9	62·5	— 0·8	54·0	74	4·6	2·80	— 1·64	9	8·0	65
Mauritius	1012·9	+ 0·9	87	66	84·4	71·1	77·7	— 0·3	73·6	70	4·7	1·44	— 7·93	18	8·3	68
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	3·06	— 0·91	..	..	..
Calcutta, Alipore Obsy.	1009·3	— 0·6	99	63	93·4	70·8	82·1	+ 2·0	71·1	80	3·6	0·43	— 1·01	2*	..	..
Bombay	1009·9	— 1·0	94	69	86·9	72·2	79·5	0·0	70·9	72	1·0	0·00	— 0·02	0*	..	..
Madras	1010·1	— 0·8	94	67	90·2	72·7	81·5	+ 0·4	75·4	81	4·2	0·01	— 0·18	0*	..	..
Colombo, Ceylon	1010·2	— 0·2	92	72	88·8	74·1	81·5	+ 0·2	76·6	69	6·5	2·67	— 2·00	7	7·9	65
Hongkong	1016·7	+ 0·6	77	47	68·8	60·1	64·5	+ 1·2	59·1	74	8·1	7·23	+ 4·44	12	3·9	32
Sandakan	..	..	90	73	87·9	74·6	81·3	+ 0·2	77·1	83	..	3·68	— 4·37	7	..	..
Sydney, N.S.W.	1020·0	+ 3·8	83	55	73·8	62·5	68·1	— 1·2	63·6	77	6·4	4·23	— 0·56	15	6·0	49
Melbourne	1020·7	+ 3·7	99	42	76·2	56·3	66·3	+ 1·8	58·1	59	4·9	0·46	— 1·80	6	6·9	54
Adelaide	1020·0	+ 2·9	106	49	85·3	60·5	72·9	+ 3·1	59·1	36	3·9	0·05	— 1·00	2	8·6	70
Perth, W. Australia	1015·4	+ 0·1	99	55	85·4	66·2	75·8	+ 4·7	65·6	59	4·1	0·32	— 0·46	5	9·1	74
Coolgardie	1016·6	+ 1·8	107	55	86·0	62·7	74·3	+ 2·6	62·4	58	5·7	1·49	+ 0·75	8	..	..
Brisbane	1017·8	+ 3·4	87	60	80·5	64·7	72·6	— 1·7	67·2	71	5·5	2·85	— 2·71	20	7·8	63
Hobart, Tasmania	1019·6	+ 5·6	86	41	69·7	51·0	60·3	+ 0·9	54·0	65	5·5	0·62	— 1·08	7	7·2	58
Wellington, N.Z.	1020·4	+ 3·2	70	43	64·9	52·3	58·6	— 1·9	55·9	76	6·0	0·41	— 2·92	3	7·9	64
Suva, Fiji	1009·3	+ 0·8	92	70	86·4	75·5	80·9	+ 0·8	76·6	81	6·6	14·20	— 0·50	23	5·7	47
Apia, Samoa	1009·0	— 0·2	89	72	86·4	75·5	80·9	+ 1·6	77·8	77	4·1	7·13	— 6·41	16	7·4	61
Kingston, Jamaica	1013·5	— 1·4	87	65	85·5	69·4	77·5	+ 0·4	67·9	84	2·3	0·96	— 0·06	4	8·2	68
Grenada, W.I.	1010·4	— 2·3	89	72	87·5	73·8	80·7	+ 3·0	73·8	78	3·4	2·25	— 0·49	12	..	..
Toronto	1009·4	— 7·6	51	15	37·3	24·8	31·1	+ 2·2	25·8	62	6·1	3·20	+ 0·55	17	4·5	38
Winnipeg	1016·0	— 2·8	39	—13	28·5	9·8	19·1	+ 4·7	..	..	4·2	0·98	— 0·13	8	6·1	51
St. John, N.B.	1004·8	— 9·4	48	4	37·3	23·2	30·3	+ 1·9	25·2	70	5·0	5·17	+ 0·63	13	5·8	49
Victoria, B.C.	1018·8	+ 3·0	66	32	51·2	39·7	45·5	+ 2·3	40·6	73	7·3	2·25	— 0·30	13	5·3	45

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

M.O. 326.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 65
Oct., 1930
No. 777

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH; YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 15, DONEGALL SQUARE WEST, BELFAST; or through any Bookseller.

British Association for the Advancement of Science. Meeting at Bristol, September 3rd to 10th, 1930

Although purely meteorological papers and discussions played little part in the Bristol meeting of the British Association, border-line topics were well represented, and provided ample interest for the meteorologists present.

On the morning of September 4th the proceedings in Section A (Mathematical and Physical Sciences) opened with a discussion on " The Meteorological Relations of Atmospherics." In opening the discussion Mr. R. A. Watson Watt said that the immediately active work on the origin of atmospherics is associated with the names of Appleton, Austin, Bureau, Dean and Harper, Lugeon, Paolini, Schindelhauer and himself. He described briefly the present working hypothesis of each of these authors, and summarised critically their experimental work, illustrating the examination by the discussion of typical cases. He then stated the most definite conclusions as to the meteorological relations of atmospherics which a normally critical physicist would regard as justified by the existing experimental evidence, and suggested critical tests to resolve some of the differences of view.

Mr. F. Entwistle read a communication from M. R. Bureau, in which he illustrated the principle of his method of recording atmospherics. These included the recording of different cate-

(91254) P.S.14/89 1,050 10/30 M. & S. *Gp.303*

gories, the separation of strong from feeble atmospherics, the registration on different wave-lengths and the influence of wave-lengths on diurnal variation. Results obtained at Mt. Valerien and St. Cyr were compared, and examples were given of long-range and of local atmospherics. Finally, he discussed the amplitude of the night maximum and its variations with latitude and longitude.

Prof. E. V. Appleton, F.R.S., pointed out that it seemed desirable to ascertain whether a case could be made out for a predominantly terrestrial origin of atmospherics, and he therefore considered the various extra-terrestrial sources which have been suggested. He concluded, however, that the thunderstorm mechanism seems a more likely source. He then called attention to the experimental fact found by Watson Watt, Herd and himself that for atmospherics of local origin, negative electrostatic field changes are about 1.5 times as frequent as positive, while for those of distant origin positive radiation field changes are about 1.5 times as frequent as negative.

Mr. C. S. Durst, speaking on behalf of Mr. M. A. Giblett, described how observations of the sources of atmospherics made at the Radio Research Station, Slough, at 13h. G.M.T. daily were transmitted immediately to the Meteorological Office, Royal Airship Works, Cardington, Beds., where they were plotted on the current synoptic weather charts and studied in connexion with them. He outlined the results of this experiment in synoptic meteorology.

On Saturday, September 6th, some 350 members of the British Association visited the recently opened Bristol Municipal Airport at Whitchurch. An excellent "Garden Party and Air Display" was organised by the Bristol and Wessex Aeroplane Club, and the flying programme included aerobatic displays, bombing competitions, demonstrations of different types of aircraft including the Autogiro, a parachute descent and "joy riding." The programme also included a demonstration by the Meteorological Office of weather forecasting. Although threatening clouds covered the sky, no rain occurred during the greater part of the afternoon, and the demonstration was given in the open air. With the collaboration of the Signals Branch of the Air Ministry, weather maps for 10h. and 13h. were constructed from broadcast synoptic data picked up on a temporary aerial. A "Local Daily Weather Report" containing a forecast for the ensuing 24 hours was prepared and displayed, together with other charts and diagrams. The demonstration attracted very considerable attention, not only from members of the Association, but also from local and visiting pilots, many of whom had flown from distant places in adverse weather conditions. In a short speech to the visitors, the Lord Mayor of Bristol (after consultation with the meteorologist in charge of the demonstration) repudiated a suggestion that his arrival was the cause of the cessation of rain which had threatened to mar the proceedings.

On the morning of Monday, September 8th, Dr. F. E. Smith, C.B., C.B.E., Sec.R.S., delivered the Presidential Address to Section A, choosing as his subject "The Theories of Terrestrial Magnetism." Dr. Smith began by referring to early magnetic conferences and resolutions urging international co-operation, and questioned whether our plans are sufficiently well laid. He pleaded for the adoption by many of the first-class magnetic observatories of a programme of simultaneous observations with similar instruments of great sensitivity, emphasising that while each observatory should have its own problems and its own methods of attacking them, and thus preserve its individuality, it should in addition have part of its equipment of an international type and part of its programme truly international in character.

The President then discussed in technical detail the cause of the earth's magnetism and the cause of its variations. He said that there were three theories, the first and simplest being that the earth was a large permanent magnet due to the magnetization of the material of which it consisted. The second supposed that the electric charge on the earth's surface produced the magnetic field by its rotation. The third possibility was that the earth was an electro-magnet, the magnetizing currents being either outside the earth or within it, on a plan which had been roughly illustrated by Wilde's famous magnetarium. But Gauss had given criteria showing that the main origin of the earth's magnetic field was within the earth and Schuster that the cause of the daily variations was external to the earth's surface. Any predominant magnetic effect due to external causes need not be looked for. None of these theories are completely satisfactory, and consequently, as the late Dr. Chree remarked, the deductions from them are just as hypothetical as the theories themselves. Hence, in conclusion, he emphasized that data of a precise kind are much needed to modify existing theories and to produce new ones.

On Monday afternoon, Dr. C. E. P. Brooks read a paper in Section E (Geography) on "Changes of Climate in the Old World during Historic Times," of which the following is a summary:—

The paper studies the distribution of climate over Europe, Asia and northeastern Africa during five critical periods. In the first, between 2500 and 2000 B.C., the whole area seems to have been abnormally dry, but especially western and central Europe, where the drying up of the lakes shows that the rainfall was probably only about half the present amount. In England easterly winds prevailed. The second period, between

800 and 400 B.C., was abnormally rainy in northwestern and central Europe, and probably rainier than at present in southeast Europe, southwest Asia and northeast Africa. The raininess in Europe, however, was not so abnormal as the dryness of the first period. The climate of the third period, from 0 to 200 A.D., has been the subject of great controversy. A critical discussion suggests that conditions probably differed little from the present, but such differences as did exist were in the direction of heavier rainfall in northwest Europe and perhaps also in the Mediterranean. In this connexion an appendix by Miss L. D. Sawyer analyses a remarkable calendar compiled by Claudius Ptolemaeus in Egypt. The fourth period, 300 to 800 A.D., was on the whole dry; the droughts seem to have reached their greatest intensity in the seventh century in Asia between 30°N. and 45°N. An analysis by Mr. C. E. Britton of a number of droughts described by chroniclers in England is given in an Appendix, which shows that they have little foundation. The last period, the twelfth to fourteenth centuries, was remarkably wet and stormy in the countries bordering on the North Sea. The coasts of Friesland, Holland and eastern England were struck by a series of catastrophic " storm floods," which wrecked the coastal defences of Holland and formed the Zuyder Zee. Probably the region between the eastern Mediterranean and central Asia was also rainier than at present.

A great deal more evidence is required before a detailed account can be given of the course of climatic changes in the historical period. It is suggested, however, that since about 800 B.C., the variations have been of the nature of local departures, first one region and then another experiencing an excess or defect of rainfall, on a similar scale to the changes which now occur from one decade to another. The first period discussed, 2500 to 2000 B.C., was on a quite different plane; the weather of Europe, Asia and Africa must have presented marked differences from the present, probably sufficient to warrant appeal to world-wide or cosmical forces.

Afterwards Professor A. E. Douglass gave a very interesting account of " Past Changes in Climate in Relation to Settlements in the New World," in which he described his researches into the tree-rings of Arizona. He showed that in that dry climate there is very close agreement between the amount of rainfall in a year and the width of the annual ring of tree-growth formed in that year. The variations of rainfall are generally similar over an extensive area, and he showed photographs of sections of trees 120 miles apart in which the parallelism leapt to the eye. Thus, by means of the growth rings of living pine trees an idea of the variations of rainfall could be formed over a period of five or six hundred years. By studying the beams used in building the Indian villages of about 1400 A.D., often preserved only in the form of charcoal, it was possible to go very much further, and to extend the record of the pines back well towards the beginning of the Christian era. An interesting result of this study was that it was possible to identify the year in which the trees forming many of the logs had been cut, and so to date the villages with remarkable accuracy. The complete series of records is likely to prove of the greatest possible value for studies of periodicities.

On the same afternoon Mr. L. A. Cammiade gave to the anthropologists an account of " Pluvial Periods in Palæolithic India," in which he demonstrated the occurrence of three periods of heavy rainfall and three dry periods near Madras.

On Tuesday, September 9th, two interesting discussions took place. The physicists discussed " Flow in Gases," the speakers being Mr. E. Ower, Mr. F. C. Johansen, Mr. E. G. Bilham and Mr. C. S. Durst. The first two speakers are members of the staff of the National Physical Laboratory, and their contributions dealt purely with the methods of measuring gas flow under laboratory conditions. Mr. Ower, whose work on the measurement of low air speeds, is well known, described the precautions necessary for obtaining accurate results with the pitot-static tube and also gave an account of a new manometer designed to measure with precision the small differences of pressure set up by air speeds of the order of 2 feet per second. Mr. Johansen emphasized the advantages of the hot-wire anemometer, especially when it was desired to make measurements at specific points in regions where the velocity varies rapidly from point to point.

Mr. Bilham in a paper on " Some Recent Improvements in Meteorological Anemometry " gave a brief account of the improvements made since 1925 in both the design and distribution of anemometers in the British Isles. Investigations at the National Physical Laboratory by L. F. G. Simmons and F. C. Johansen* between 1925 and 1928 led to the adoption of an improved form of Dines' anemograph with a shielded head and connecting pipes of 1-in. steel tubing. Charts exhibited at the meeting showed that the number of Dines' anemographs whose data are regularly published in the *Monthly Weather Report* had increased from 27 in 1925 to 36 in 1930 and that 18 of the stations operating in 1930 were equipped with instruments of the improved pattern. An account was also given of the 3-cup Robinson anemometer designed by J. Patterson of Toronto. This instrument has been adopted as standard by the Meteorological Service of Canada and the United States Weather Bureau. Test data show that Patterson's 3-cup system might with advantage replace the 4-cup systems on small Meteorological Office anemometers of the electric and indicating patterns.

---

* See *Meteorological Magazine*, 64, 1929, p. 7.

In the absence of Mr. M. A. Giblett, Mr. C. S. Durst gave an account of the investigation on wind-structure carried out by the Meteorological Office, Royal Airship Works, Cardington. By utilising Dines' anemographs fitted with quick running clock-drums, information has been obtained regarding the travel of disturbances superposed on the main wind stream, over an area of linear dimensions approximately equal to the length of a rigid airship such as H.M.A.S. R.101. The information so obtained is not only of meteorological interest but of considerable practical value in connexion with the design of airships and mooring towers.

The geographers, anthropologists and geologists combined for a prolonged discussion on "The relations between past Pluvial and Glacial Periods," under the chairmanship of Prof. H. J. Fleure. The evidence for pluvial periods in the Faiyum, Palestine, Kenya and Rhodesia was set out by Miss E. W. Gardner, Miss D. A. E. Garrod, Mr. L. S. B. Leakey and Dr. Armstrong; the sequence is most clear in Kenya and Uganda where, as Mr. Leakey explained, the lake beaches show a late Pliocene and early Pleistocene wet period or "pluvial," a long relatively dry "inter-pluvial" accompanied by earth movements, and a second pluvial with two peaks, followed by an arid period and two "post-pluvial" wet stages. Dr. G. B. Barbour described the pluvial and inter-pluvial periods in China, where, he said, pluvial periods coincided with inter-glacial periods in Europe and inter-pluvial periods with glacial periods. On the glacial side the position was much less clear; there is as yet no agreement as to the number of glacial periods in different countries, and so far from the glacial advances in different areas being contemporaneous, Prof. J. W. Gregory explained that there is much evidence that in Europe and North America different glacial centres reached their maxima successively. It appeared that there is no possibility as yet of correlation between the various glacial advances of the Alps and Scandinavia. Only Prof. W. J. Sollas held out for the definite acceptance of the scheme developed by Penck and Brückner in the Alps, which postulates four glacial advances, the first and second and the third and fourth being separated by short inter-glacials and the second and third by a much longer inter-glacial.

Dr. C. E. P. Brooks described to the meeting the theory of the ice age developed by Dr. G. C. Simpson,* who was unfortunately not able to be present. This theory would have as a definite result that the first two glacial periods and the first interglacial of Penck and Brückner's scheme would be represented by a pluvial period, the long second interglacial would be an interpluvial period, and the third glacial, third interglacial and fourth glacial would be represented by a second pluvial period. Thus Dr. Simpson's theory agrees closely with the facts set out by Mr. Leakey.

---

* Past Climates. Alexander Pedler Lecture 1929. Manchester, Mem. Lit. Phil. Soc., 74, 1929-30, pp. 1-34.

Dr. Brooks then proceeded to explain his own views of the correlation, which agreed in the main with those of Dr. Simpson. He thought that while the details of the series of glacial advances and retreats might be obscure, there could be little doubt of the existence of one important interglacial corresponding with the Mindel-Riss of Penck and Brückner's scheme. The other interglacials, if they existed at all, were on a much smaller scale. He explained that the general amount of rainfall over the globe must equal the amount of evaporation, which in turn rested mainly on the wind velocity, governed by the strength of the atmospheric circulation and ultimately, by the temperature difference between equator and poles. Whatever the initial cause of glaciation, the great cooling power of ice resulted in a stronger circulation and heavier rainfall during glacial periods. This heavy rainfall would not be uniformly distributed however, but would fall mainly on the equatorial flanks of the glaciated regions and near the equator, all places where pluvial periods were well developed. On the other hand, we should expect that regions which owed their rainfall to monsoons, developed in spite of and against the general direction of the atmospheric circulation, would experience a smaller rainfall during glacial periods, and this accounted for the succession described by Dr. Barbour in China and Mr. Cammiade in India. In the afternoon the Chairman summed up the results of a very fruitful discussion, but some of the speakers continued it informally over the tea-table until a much later hour—an opportunity of the sort for which meetings of the British Association are often responsible.

Apart from the papers and discussions, the Bristol meeting was memorable for the numerous and admirably arranged excursions, which included Bath, Stonehenge and Avebury stone circle, the Cheddar Gorge and other famous places of interest, while such small amount of leisure as these attractions left to the members could be spent in the reception room and writing room of the palatial building of the University, opened to the Association as its headquarters by the courtesy of the University authorities.

OFFICIAL NOTICE

Discussions at the Meteorological Office

The series of meetings for the discussion of recent contributions to meteorological literature, especially in foreign and colonial journals, were resumed at South Kensington on Monday, October 13th. The subject for this meeting was a paper by Tor

Bergeron entitled *On three-dimensional constructive analysis of weather*. Part I. (Oslo. Geofys. Publ. Vol 5, No. 6), (in German). The discussion was opened by Sir Gilbert Walker, C.S.I., F.R.S.

The meetings are held on alternate Mondays at 5 p.m. The subjects for the next two meetings are:

October 27th, 1930. *On persistence and coagulation of fog and clouds*. By A. Wigand and E. Frankenberger. (Phys. Zs., Leipzig, 31, 1930. pp. 204-15), (in German). *Opener*—Mr. F. J. Scrase, M.A., B.Sc.

November 10th, 1930. *Illumination from sun and sky in the neighbourhood of Stockholm in* 1928. By T. E. Aurén. (Stockholm, Stat. Hydro-Meteor. Anst., Medd. 5, No. 4, 1930.) *Opener*—Mr. P. I. Mulholland, B.Sc.

The dates for subsequent meetings are as follows:—

November 24th, December 8th, 1930, January 12th and 26th, February 9th and 23rd and March 9th, 1931.

The Director of the Meteorological Office wishes it to be known that visitors are welcomed at these meetings.

Official Publications

The following publications have recently been issued:—

The Meteorological Glossary. In continuation of the Weather Map. 2nd edition, entirely rewritten (M.O. 225ii). Pp. 233. *Illus.* Price 4s. 6d.

The first edition of the Meteorological Glossary was issued in 1916, and was reprinted with additions in 1917 and again in 1918. Since 1918 there have been many advances in meteorology, for example, in connexion with the study of weather maps, and the new edition has been almost completely re-written. Each article is the work of an expert in the branch of meteorology with which it deals, but care has been taken to keep the style clear and readable throughout, while the various articles are co-ordinated by a simple system of cross-indexing. The 233 pages contain 618 articles ranging from a few lines to four pages in that on *Rain*. Among other articles to which special reference may be made are: *Depression*, giving a full account of the modern theories about the structure of barometric depressions, *Clouds*, illustrated by eight half-tone reproductions, and *Radiation*, in which the application of important principles of physics to meteorology is clearly explained. For use as a book of reference, the various tables have been brought as nearly as possible up to date, and the latest available determinations of physical constants have been employed throughout. The new edition is given a larger page than the earlier issues, a change which has facilitated the use of illustrations, and in addition to numerous figures in the text, there are a series of photographic reproductions of clouds and other meteorological phemomena, and six lithographs in colour of typical weather charts. To assist in reading meteorological papers in foreign languages, the new edition contains also a long list of technical terms, which are not generally found in dictionaries, in Danish, Dutch, French, German, Italian, Norwegian, Portuguese, Spanish and Swedish. The volume is attractively bound in blue cloth boards lettered in gold.

Annual Report *of the Director of the Meteorological Office, presented by the Meteorological Committee to the Air Council, for the year ended March* 31, 1930.

This report describes the activities of the Meteorological Office during the seventy-fifth year of its existence and the tenth year in which its cost has been borne on Air Ministry votes. The year was one of great activity in international co-ordination and, as well as meetings of several commissions, the report includes accounts of three important conferences—the International Conference on the Safety of Life at Sea which met in London during April and May, 1929, the Conference of Empire Meteorologists in London in August and the International Conference of Directors of Meteorological Services at Copenhagen in September. These conferences led amongst other things to the recognition of marine meteorology in international treaties, to a radical improvement in the interchange of meteorological data throughout the world, and to a much closer connexion between the meteorological services of the British Empire.

In the actual work of the Office during the year outstanding features were the adoption by the Forecast and Aviation Services on March 1, 1930, of the new international code for the transmission of meteorological messages, which was approved at the Conference of Directors at Copenhagen, and the arrangements made by the Airship Services Division in connexion with the trials of H.M. Airships R.101 and R.100.

Correspondence

To the Editor, *The Meteorological Magazine.*

Cyclones and Anticyclones

In your September number Captain Douglas begins the concluding paragraph of a note on "The Recent Heat and Thunderstorms" with the remark that the problems of anticyclones and cyclones are very closely analogous and will probably be solved together.

Recent examination of the subject leads me to express the view that anticyclones and cyclones are not two problems but two aspects of a single problem, namely, the production of velocity in the atmosphere.

I have worked for years on the hypothesis that in the upper air the wind-velocity practically balances the gradient of pressure by the aid of the deviating force of the earth's spin and local centrifugal force (both at right angles to the motion); and now I go a step further and explain that if the velocity is too small for the balance there will an uncompensated component of force across the flow down the gradient tending to reduce it; but if, on the other hand, the velocity is too big for the balance the uncompensated component will be up the gradient and so available for throwing air along an isentropic surface from left to right of the path and increasing the gradient.

In either case the effect of the uncompensated component will be continued until the proper gradient for balance has been created.

So the general motion of the atmosphere is a continuous process of spontaneous adjustment of the pressure to the motion; and as the process operates at every level of the moving air, and commences automatically with any deviation whatever from the strophic balance, the adjustment of pressure to motion will be as automatic as that of the attitude of a bicyclist on the road or a skater on the ice. To me this dual aspect of the question is new; but I am glad to say that I find a number of my friends already regard it as commonplace, which indeed it might quite well be for it is obvious enough when once stated.

Margules indeed appeared to be at a loss to account for an increase of pressure by motion of air up the gradient; but now it is clear that the cross acceleration is no exceptional occurrence, it happens automatically if the velocity is too big for balance.

Hence we may understand that a cyclone will be dug, on the left-hand side, and. by the same action, an anticyclone piled up on the right-hand side of any current of air in the atmosphere except indeed at the equator.

This view throws the burden of the meteorological problem on discovering the origin of velocity. I have not seen the problem so stated in the text-books; but one can gather some information about it from Helmholtz's papers. I had hitherto assumed that the gods first created pressure-difference and nature converted it into velocity; but now I think the gods create velocity and nature converts it into pressure-difference, and I should very much like to know what are the gods in this case and how they do it; the only ones I can think of are the downward convexion of cooled air, the upward convexion of saturated air and the conservation of moment of momentum. I wonder if your readers have any more. NAPIER SHAW.

10, Moreton Gardens, S.W.5. September 18*th*, 1930.

The Recent Heat and Thunderstorms

I have read with interest the article under the above heading which appeared in the *Meteorological Magazine* for September, 1930, p. 177. On the subject of researches into the causes of these high temperatures, permit me to indicate that the explanation can be found in the variations of the solar phenomena.

Indeed, observation shows that in our countries in the west of Europe—

1. All increase of sun-spots or faculæ is followed by a rise in temperature.
2. All decrease of sun-spots or faculæ is followed by a fall of temperature and by the formation of barometric depressions on the North Atlantic.

These two cases are shown in the variations of the temperature during the last month: the increase of sun-spots from the beginning to the 24th of August has been followed by very high temperatures until the decrease of these spots from September 5th to 10th. On the other hand the decrease then, the absence of sun-spots on September 18th and 19th, has been followed by a violent storm over the west of Europe.

Table I.—The highest temperatures of the summer of 1930 (end of August to the beginning of September) have coincided with a recrudescence of sun-spots.

In a great number of cases and with excessively simple methods such as that which consists in comparing, each day, the number of sun-spots with the variations of temperature, the relation can be seen which, in the west of Europe unites these two phenomena. It is therefore easy to state that the very high temperatures beween August 24th and September 6th have coincided exactly with a persistent recrudescence of sun-spots at this epoch.

	Sunspots No. of groups (each day).		Sunspots No. of groups (each day).			Sunspots No. of groups (each day).	
Aug. 15th	1	Aug. 24th	4	Recrudescence of persistence solar activity	Sept. 8th	4	
,, 16th	1	,, 25th	4		,, 9th	(3)	
,, 17th	1	,, 26th	4		,, 10th	2	
,, 18th	3	,, 27th	5		,, 11th	3	
,, 19th	3	,, 28th	4		,, 12th	2	
,, 20th	3	,, 29th	4		,, 13th	3	
,, 21st	2	,, 30th	4		,, 14th	4	
,, 22nd	2	,, 31st	4		,, 15th	2	
,, 23rd	2	Sept. 1st	5		,, 16th	2	
		,, 2nd	6		,, 17th	1	
		,, 3rd	6		,, 18th	0	Violent tempest over the west of Europe. The decreases of sun-spots or faculæ are always followed by the formation of depressions over the North Atlantic.
		,, 4th	7		,, 19th	0	
		,, 5th	5		,, 20th	1	
		,, 6th	7				
		,, 7th	7				

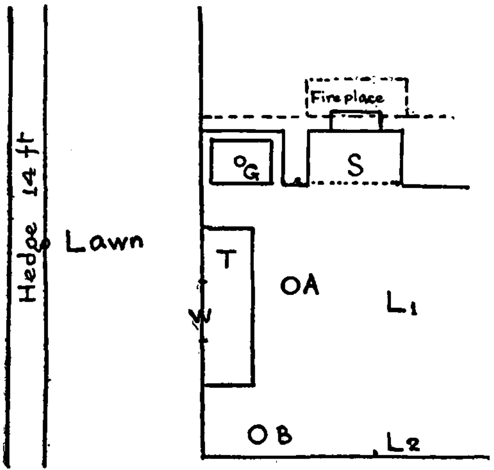
Summarising, the cause of the principal atmospheric changes in our countries is found generally in the variations of the solar phenomena, but it is indispensable to note, each day, the continual modifications which are produced on the surface of the sun.

HENRI MÉMERY.

Observatoire de Talence, Gironde, France. September 24th, 1930.

Ball Lightning

The following is an account of what was probably a case of ball lightning seen at Remuera, a suburb of Auckland, at about 17h. 5m. on June 9th, 1930. Lightning was seen during the afternoon, but no thunder or lightning was observed in the vicinity at the time mentioned. The weather was dull with "clouds like thunderclouds," but no precipitation was falling. The report of the occurrence was handed to Prof. P. W. Burbidge, of the Auckland University College, by a senior student, Mr. M. J. O'Sullivan.



In the sketch, G is a central iron flue leading from above a gas stove straight through a galvanised-iron roof; S is an iron cooking stove. The gas stove was alight at the time, but the other stove was not. T is a table against a window. L_1 is an electric lamp which was burning, and L_2 is a wall lighting point. Mr. O'Sullivan was sitting at B talking to his mother, who was facing him at A.

Suddenly there was a loud and sharp explosion, accompanied by a very bright yellow flash. The flash appeared to Mr. O'Sullivan to be horizontal and in a line from near the stoves to a point below L_1. To Mrs. O'Sullivan it appeared head high and to her right rear. The electric light and the gas stove continued to burn and nothing was damaged or disturbed. No smell was observed. The explosion was not due to escaping gas.

EDWARD KIDSON.

Meteor. Branch, Dept. of Scientific and Industrial Research, Wellington, New Zealand. June 18th, 1930.

A Northumberland Thunderstorm

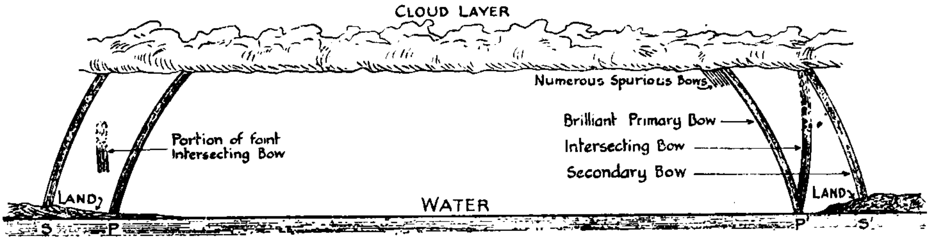
On the afternoon of Tuesday, August 12th, there was an outbreak of violent thunderstorms over north-east England and south-east Scotland. At Rothbury we caught the edge of one of the storms, there being one or two heavy crashes of thunder immediately after vivid flashes of lightning with some rain and hail. But the remarkable feature here was the sky, the like of which I do not remember having seen before during the actual progress of a storm. The moors all around were wrapped in a deep blackness through which the dark craggy edge of the Simonside Hills stood out with menacing effect; but the valley of the Coquet lay for nearly half an hour beneath a rift of pure blue sky, bordered on either side by massive sun-lit clouds throwing on to the valley a lovely silver light of remarkable intensity.

L. C. W. Bonacina.

Rothbury, Northumberland. August 20th, 1930.

Intersecting Rainbows.

On the evening of August 12th, whilst camping on the foreshore, on the Scottish side of the Solway Firth near Brow Houses, towards 7 p.m. G.M.T. during a local thunderstorm which was moving southwestwards across the Firth, I observed an unusually brilliant primary rainbow together with a secondary with numerous spurious bows on the under side of the southernmost portion of the primary. The bows were not complete as there was an interrupting cloud layer at approximately 2,000ft. level. The important part, however, of the observation was the appearance of an intersecting bow between the southern extremity of the primary and the secondary bow, the intersection at the primary being sharp at the extremity whilst the intersection and ending of the secondary bow was less sharp, inclining towards a fade out, the intersection here taking place near the cloud level. The colours of the intersecting bow were brilliant and of the same order as those of the primary. The whole phenomena on the southern portion of the rainbow resembled the letter N, but with the connecting stroke in the reverse direction, as shown in the sketch.



Such an intersecting bow arises from the presence of two sources of parallel rays. In the present instance one set was that coming directly from the sun giving the primary and the secondary bows and the other set from the image of the sun in the bay to the westward of the point of observation. The image being as much below the horizon as the sun was above it, the centre of the intersecting bow was thus as much above the horizon as the centre of the primary was below it. The displav lasted for nearly half an hour and was watched by a number of people. The water in the Solway was at low tide and almost perfectly calm. To the north side there were at times only faint traces of the intersecting bow.

J. CRICHTON.

6, Drumsheugh Gardens, Edinburgh. September 4th, 1930.

Red Sunrises and Sunsets.

I read with much interest the article by Spencer Russell on this subject. From a lad I was interested in forecasting weather by sunset colour and became fairly proficient and now in my later life it is my hobby—and my experience is red sunrise will enable one to forecast wind or rain during the 24 hours. Sunset reds are varied and the only colour which can be depended upon is the rosy afterglow colour; at times the faint colours from the setting sun's rays are yellow and then generally followed by a pinky red and rain is sure to follow and at times severe winds. I have rarely been out in my local forecast for the following day and as a rule these colours are in harmony with the use of barometer, wind changes, temperature, humidity which I note daily to assist in my forecasting.

I have tested these sunset colours away from home without the aid of instruments and have rarely if ever failed in correct forecast. Now in my 85th year I hold to this experience.

HENRY A. ROGERS.

31, Fernbank Road, Redland, Bristol. August 27th. 1930.

Halo Phenomena in False Cirrus.

In the *Meteorological Magazine* for September (p. 187) S. E. Ashmore directs attention to this phenomenon. I remember during the war an observer noticed part of a halo in the extension of an anvil cloud and remarked that false cirrus is true cirrus. I am glad to say that the same view was taken by the International Commission for the Study of Clouds and the absurd name of false cirrus has been suppressed. In the new International Atlas of Clouds, which, in its abridged form, has just been published, the cloud in question is called cirrus nothus, which I think may well be translated hybrid cirrus; the name may not be free from criticism but it does express the mode of origin of the cloud whereas the term false cirrus does not express anything at all.

C. J. P. CAVE.

Stoner Hill, Petersfield. September 24th. 1930.

Peculiar Cloud Phenomena

At 15h. 43m. yesterday (Wednesday) a very unusual cloud effect occurred here. Through an evil-looking mass of nimbus and cumulo-nimbus in the east a pencil-like " shaft " of cloud penetrated downwards as in Fig. 1. The shaft appeared very black and dense—more so than the cloud mass. Within two minutes the " pencil-point " had broken off and the entire " shaft " rapidly dissolved upwards! A couple of minutes later another strange sight presented itself in a neighbouring system of large yellowish cumulus as in Fig. 2,—the pendulous " rat-tail " being jet-black. It suddenly unrolled itself (like an elephant's trunk) from the cloud and had vanished within two minutes.

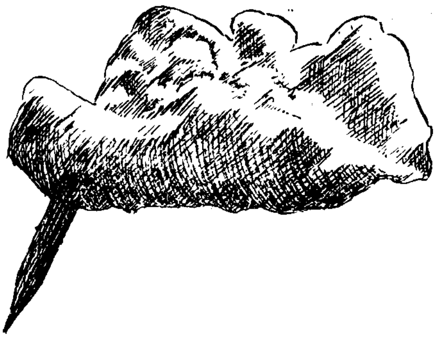


FIG. 1

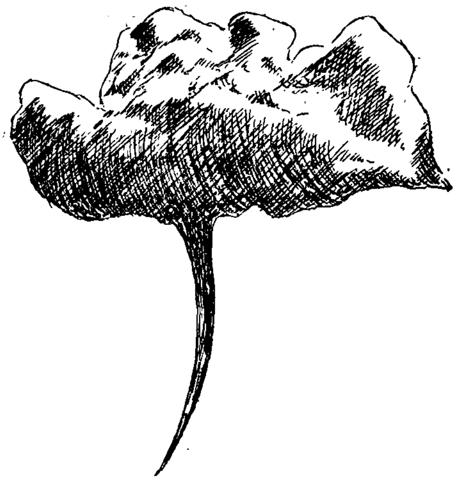


FIG. 2

The whole cloud system slowly advanced from south and partly encircled the house from south through southeast and east to northeast and north. No rain fell here but a few spots occurred to northwest of Ross some 5 miles distant (How Eaple). There was no thunder and wind was dead calm followed by light airs from SW. to SSW. Western sky less cloudy with " rocky " cumulus near horizon and some alto-cumulus. Barograph remained steady.

The first phenomenon approached to within 8° of the horizon and the second about 5° from the horizon.

The " funnel " actually came down to ground level at Weston-under-Renyard (2 miles eastsoutheast of Ross) and was described as a column of revolving smoke. As it touched earth it caused a " splashing shower and left a large wet patch."

F. J. PARSONS.

The Observatory, Ross-on-Wye. September 11th, 1930.

The Drought in North America.

In view of the article bearing the above title in the September issue of the *Meteorological Magazine*, the following extract from a letter I received from a clergyman working in British Columbia may be of interest. It is dated August 4th from Salmon Arm, B.C.

"We are enjoying nice summer weather 95° in the shade, no rain for 3 months, forest fires abound, the smoke is terrific. However, next month will see it cooler, but rain is needed badly and prayers are being asked for by all our farmers . . . my shack as I sit here is 98°."

CICELY M. BOTLEY.

Guildables, 17, Holmesdale Gardens, Hastings. September 18th, 1930.

NOTES AND QUERIES

Official Course of Training for Observers

Twenty-five people attended this course; nine came from Health Resorts, the remainder from crop-weather stations or the Ministry of Agriculture. It was found that the accommodation at Kew was insufficient, but as this was not known until it was too late to inform all those who had applied to take the course, it was arranged that all concerned should attend at Kew on the first morning, when Dr. Whipple and Mr. Scrase explained some of the work of the Observatory. The course was then continued in the Library of the Meteorological Office, South Kensington. It followed the lines of previous courses, but advantage was taken of facilities for showing slides when discussing British climatology. Mr. E. G. Bilham, Superintendent of the British Climatology Division, explained to the crop-weather observers at the end of the second afternoon the new form for compilation of monthly and weekly summaries from a single sheet, while the rest of the party saw the arrangements for testing instruments in the Instruments Division.

E. V. NEWNHAM.

The Santo Domingo Hurricane

A report appeared in *The Times* of September 4th that a hurricane of considerably intensity had passed over Dominica on September 1st, resulting in two deaths and causing considerable damage to property. The hurricane was said to have passed over Porto Rico and to have devastated Santo Domingo city, but the real extent of the disaster at Santo Domingo was not made known until more detailed reports were received in the next few days.

It appears that the hurricane moving from southeast struck Santo Domingo at 2 p.m. on the 3rd, its full force lasted for four hours, the wind at times reaching 130 to 160 m.p.h., and owing to the damage to the wireless station and the land station of the submarine cable company, communication with the outside world was interrupted for nearly 24 hours. When communication was restored the magnitude of the disaster increased in each successive report. It is now believed that over 4,000 persons lost their lives and 5,000 were more or less seriously injured, one-quarter of the entire population of the city being involved, and over three-quarters of the total number of houses in the city are estimated to have been destroyed. The water supply plant being much damaged, the prospect of outbreaks of disease had to be provided against and as the medical supplies in the neighbouring islands were quickly exhausted, arrangements were made for conveying fresh supplies by aeroplane. Extensive relief work was soon organized in the United States, Porto Rico, Cuba and Haiti, and several shiploads of supplies reached the city within a few days. The hurricane seems to have attained destructive intensity only in the neighbourhood of Santo Domingo and was stated to have lost some of its intensity in the mountains of Haiti. A report from San Pedro de Macorio, some 40 miles to the eastward, stated that only a 60 miles an hour gale was experienced there. No reports of damage seem to have been received during the further progress of the storm across the Bahamas towards Florida. Later reports showed that the damage in Dominica though slight in comparison with that inflicted on Santo Domingo was more extensive than was at first thought. Six people lost their lives, the damage to public works is estimated at £10,000 and about 50 per cent of the lime crop, 75 per cent of the coconut crop and the whole of the late cocoa crop are said to have been destroyed.

Extensive reports on West Indian hurricanes have been published by the United States Department of the Agriculture Weather Bureau. These show that the hurricane season is at its height during August and the first part of September, but previously September hurricanes have usually avoided the island of Haiti, the tracks pursued from the Lesser Antilles generally lying to east or south of the island. The most destructive storm as regards material damage, in the West Indies of recent years was that of September 13th, 1928, in Porto Rico. On this occasion the loss of life did not exceed 300, owing to the approach of the storm having been announced in time for precautions to be taken. In the storm of August 8th, 1899, over 3,000 lives were lost in Porto Rico, a figure which has unfortunately been exceeded in the recent disaster in Santo Domingo.

S. T. A. Mirrlees.

A Storm on Victoria Nyanza

The second of the series of *Memoirs* issued by the British East Africa Meteorological Service consists of an account by

Mr. A. Walter, the Director, of a storm on Victoria Nyanza on the night of May 18th-19th, 1930. These storms appear to occur only in the late evening or very early morning, and are probably part of the process of readjustment after the disturbance of the air and thunderstorm conditions caused by the intense solar radiation during the day. They are of the nature of tornadoes, with winds of force 8 or 10 surrounding a calm centre; the example described from observations made on the Lake Steamer *Clement Hill*, had a diameter not exceeding 30 miles and moved slowly from south-east to north-west across the equator; the direction of rotation was clockwise.

Review

Geochronology, by G. De Geer (reprinted from *Antiquity*, Vol. 2, 1928, pp. 308-17).

The author describes the annual clay laminæ deposited by the retreating ice-sheets of the last glaciation, and the methods by which they have been dated and compared one with another. He then discusses the possible ways in which other records of the past, such as delta deposits of great rivers, and successive shore lines of glacial lakes and seas, can be accurately dated. If the ages of archæological horizons in different parts of the world could be exactly determined, much light would be thrown on the migrations of early man. We may add that the full publication of long series of such measurements extending to the present day would be of inestimable value to the study of climatic variations.

Books Received

Report on Rainfall Registration in Mysore for 1928. By C. Seshachar, M.A. Bangalore, 1929.

Nautisk-Meteorologisk Aarbog, 1929. The Danish Meteorological Institute, Copenhagen, 1930.

Obituary

DR. WILH. R. ECKARDT.—We regret to learn of the death of Dr. Eckardt, Director of the Meteorological Observatory in Essen. Born on October 11th, 1879, at Hildburghausen, Dr. Eckardt studied biology and geography; these subjects led him to bioclimatology and especially to the evidence of past climates to be derived from the study of fossils. His little book "Paläoklimatologie" (Sammlung Goschen, 1910) was remarkable for its good sense and moderation at a time when some rather wild ideas on geological climates still prevailed, and it can still be read with profit. After some experience in a publishing house, he became an assistant in the Meteorological Service of Aachen and in April, 1913, he joined the newly formed Meteorological Observatory in Essen, where he did much to reorganise the publication of meteorological data for western Germany. He became Director of the Observatory in 1919 and held the post until his death. The best known of his later works is the "Grundzüge einer Physioklimatologie der Festländer," published at Berlin in 1922, but he also inspired and guided much of the work of his younger colleagues.

With deep regret we learn of the disaster to H.M. Airship R 101 with the loss of 48 lives, including that of Mr. M. A. Giblett, M.Sc., Superintendent of the Airship Meteorology Division. An appreciation of Mr. Giblett's life and work will appear in the *Meteorological Magazine* for November.

News in Brief

Mr. G. A. Clarke, of the Meteorological Office, Aberdeen, has been awarded a medal by the Royal Photographic Society for his work on cloud photography.

The Weather of September, 1930

Unsettled weather prevailed generally over the country during the greater part of the month with temperature and rainfall above normal and pressure and sunshine below normal, except in the extreme west, where rainfall was deficient in the north and sunshine slightly in excess in the south. The opening days of the month were warm and sunny, as much as 12·6 hrs. bright sunshine being recorded at Hastings, Southport and Armagh on the 2nd, but this fine anticyclonic spell was broken on the 4th when a depression spread across the country from the west. There ensued a period of unsettled weather with frequent local thunderstorms. Slight rain fell on most days with heavy falls locally on the 10th and 12th but there were many bright sunny periods especially on the 7th, 8th and 10th when between 10 and 11 hrs. sunshine were experienced at some places. Temperature was high and on the 5th rose to above 80°F. in parts of southeast England. A severe and very local thunderstorm occurred in eastern London on the 10th, as much as 2·40in. of rain being measured at Telegraph Hill, southeast London, that day. On the 13th a depression off southwest Ireland moved rapidly eastnortheast and gave general moderate rain which was followed by a welcome sunny day on the 15th when York had 11·5 hrs. bright sunshine, Aspatria and Jersey 11·3 hrs. and Clacton, Rothesay and Rhayader 11·1 hrs. From the 17th onwards conditions became very unsettled with deep depressions passing rapidly eastwards across the country. General heavy rain occurred and strong winds and gales. The roughest weather was experienced about the 19th and 20th and the heaviest rain from the 17th-19th inclusive. At Holne (Devon) 2·26in. fell on the 17th, 1·17in. on the 18th and 1·82in. on the 19th. At Talyllyn (Merioneth) and at Tynywaum (Glamorgan) 2·20in. fell on the 19th. Thunderstorms occurred in northern England on the 19th and much fog developed in the west on the 22nd. A change occurred about the 25th when an anticyclone over the Atlantic began to spread east and increase in intensity in the rear of a depression off northern Scotland. A cold northerly current from the Arctic spread over the British Isles and on the 27th day temperatures did not exceed 50°F. in parts. Local gales occurred on a few days. From the 27th to the end of the month anticyclonic weather prevailed generally in Scotland, north England and north Ireland, but in south-eastern England weather continued cloudy with heavy rain at times, 2·45in. fell at Snape, Suffolk, on the 27th. Local thunderstorms occurred in northwest England on the 24th and in southern England on the 27th.

A notable feature of the month was the high night temperature; at Kew the mean minimum temperature was 3·8°F. above normal and at Ross-on-Wye 3°F. The minimum of 62°F. at Kew on the 23rd is a record for the last ten days of September. It was the wettest September on record at Gorleston and Phœnix Park, Dublin. The distribution of bright sunshine was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs).
Stornoway	91	— 24	Liverpool	110	—18
Aberdeen	? 73	— 51	Ross-on-Wye	118	—18
Dublin	129	— 10	Falmouth	167	+ 4
Birr Castle	110	— 16	Gorleston	124	—38
Valentia	142	+ 9	Kew	117	—28

Pressure was above normal over Svalbard, Iceland, Scandinavia, Spain, Italy and Bermuda, the greatest excess being 11·3mb. at Jan Mayen and 2·3mb. at Corunna. Pressure was below normal over most of the North Atlantic, the British Isles, France and central Europe, the greatest deficit being 3·3mb. at Tynemouth, The Helder and Horta. Temperature was generally below normal over northern and central Europe, but above normal in the south, while rainfall was generally in excess in northwest Europe but deficient in central Europe. In the northern half of Sweden rainfall was about half the normal but in north Svealand it was 20 per cent. above the normal and in south Sweden more than twice the normal locally.

A cloudburst near Catania (Sicily) destroyed many crops about the 3rd and two people were swept away by the flood. Two deaths were reported from Bilbao (Spain) on the 6th due to the excessive heat. Severe thunderstorms swept the south coast of

France and the Midi on the 11th and much damage was done. The same day a violent wind lasting about 10 minutes swept over Saint Remy de Provence leaving a track 200 yds. wide in which everything was damaged. Four waterspouts, each 90 ft. high, were seen off Posilipo (Bay of Naples) on the 15th but no damage was done on sea or land. A violent thunderstorm caused much damage to the village of Tourette-du-Château (Esterel, Var, France) on the 15th. Severe storms were experienced along the northern French coast on the 19th and 20th during which 40 Breton fishermen were drowned.

Over 100,000 people are reported to have been affected by floods caused by a sudden rise in the Brahmaputra River in the Nowgong district of Assam about the 4th. The districts of Bokoni and Laokhoa were particularly affected. At Bombay 22in. of rain fell on the 9th and 8in. on the 10th, so that serious floods resulted. Several subsidences and small landslides took place. Heavy monsoon rains continued there again on the 13th and 14th, after which the floods in the Tapti Valley were particularly severe. The fall of 22in. on the 9th constitutes a record for Colombo, the next largest fall being one of 16in. in 1886. The monsoon was active in Burma and northeast India in the week ending the 24th and active in South Peninsula the following week, during which it had retreated from north and central India.

Good rains occurred in western Australia; in the eastern States it was warm and dry at first with showery weather later.

Temperature in the United States was above normal (except along parts of the Pacific coast) during the first three weeks being as much as 10°F. above normal at Baltimore in the week ending the 23rd, while rainfall was generally below normal. Moderate temperatures with rainfall slightly under normal prevailed generally in Argentina. A hurricane of unusual intensity swept over the West Indies on the 1st-3rd.*

The special message from Brazil states that the rainfall was generally scarce with averages of 0·47in., 0·59in.,, and 0·91in. below normal in the northern, central and southern regions respectively. Five typical but not very intense anticyclones passed across the country. An unusual gale with many continued gusts over 30m/s occurred at Rio de Janeiro on the 1st. The crops were generally affected by the lack of rain. At Rio de Janeiro pressure was 1·4mb. above normal and temperature 0·5°F. below normal.

Rainfall, September, 1930.—General Distribution

England and Wales	179	per cent of the average 1881-1915.
Scotland	144	
Ireland	154	
British Isles	165	

---

*See page 216.

Rainfall: September, 1930: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Lond	Camden Square	3·58	197	*Leics*	Belvoir Castle	3·78	202
Sur	Reigate, Alvington	3·99	192	*Rut*	Ridlington	4·15	...
Kent	Tenterden, Ashenden	3·27	153	*Linc*	Boston, Skirbeck	3·67	209
,,	Folkestone, Boro. San.	3·68	...	,,	Cranwell Aerodrome	4·37	245
,,	Margate, Cliftonville	4·35	221	,,	Skegness, Marine Gdns	3·45	191
,,	Sevenoaks, Speldhurst	3·81	...	,,	Louth, Westgate	3·69	183
Sus	Patching Farm	3·16	132	,,	Brigg, Wrawby St.	3·58	...
,,	Brighton, Old Steyne	2·36	113	*Notts*	Worksop, Hodsock	3·73	245
,,	Heathfield, Barklye	4·26	174	*Derby*	Derby, L. M. & S. Rly.	3.98	241
Hants	Ventnor, Roy. Nat. Hos.	3·07	124	,,	Buxton, Devon Hos.	5·11	158
,,	Fordingbridge, Oaklnds	4·35	202	*Ches*	Runcorn, Weston Pt.	2·96	111
,,	Ovington Rectory	3·53	154	,,	Nantwich, Dorfold Hall	3·18	...
,,	Sherborne St. John	3·79	185	*Lancs*	Manchester, Whit. Pk.	2·90	122
Berks	Wellington College	3·18	173	,,	Stonyhurst College	3·53	92
,,	Newbury, Greenham	2·79	138	,,	Southport, Hesketh Pk	2·39	87
Herts	Welwyn Garden City	3·45	...	,,	Lancaster, Strathspey	2.55	...
Bucks	High Wycombe	3·82	203	*Yorks*	Wath-upon-Dearne	4·09	259
Oxf	Oxford, Mag. College	3·35	199	,,	Bradford, Lister Pk.	4·87	235
Nor	Pitsford, Sedgebrook	4·03	224	,,	Oughtershaw Hall	5·25	...
,,	Oundle	3·53	...	,,	Wetherby, Ribston H.	3·80	211
Beds	Woburn, Crawley Mill	2·59	145	,,	Hull, Pearson Park	2·85	166
Cam	Cambridge, Bot. Gdns.	...	...	,,	Holme-on-Spalding	3·16	...
Essex	Chelmsford, CountyLab	3·59	209	,,	West Witton, Ivy Ho.	4·14	...
,,	Lexden Hill House	5·09	...	,,	Felixkirk, Mt. St. John	4·38	241
Suff	Hawkedon Rectory	4·47	232	,,	Pickering, Hungate	3·89	...
,,	Haughley House	4·59	...	,,	Scarborough	3·59	201
Norf	Norwich, Eaton	5·65	264	,,	Middlesbrough	2·54	153
,,	Wells, Holkham Hall	4·18	220	,,	Baldersdale, Hury Res.	3·30	...
,,	Little Dunham	5·83	253	*Durh*	Ushaw College	2·91	145
Wilts	Devizcs, Highclere	3·76	184	*Nor*	Newcastle, Town Moor	2·86	140
,,	Bishops Cannings	3·66	164	,,	Bellingham, Highgreen	3·90	...
Dor	Evershot, Melbury Ho.	3·94	148	,,	Lilburn Tower Gdns.	3·46	...
,,	Creech Grange	3·61	...	*Cumb*	Geltsdale	2·57	...
,,	Shaftesbury, Abbey Ho.	3·15	129	,,	Carlisle, Scaleby Hall	2·09	77
Devon	Plymouth, The Hoe	5·05	198	,,	Borrowdale, Seathwaite	8·75	88
,,	Polapit Tamar	5·30	189	,,	Borrowdale, Rosthwaite	7·16	...
,,	Ashburton, Druid Ho.	7·14	229	,,	Keswick, High Hill	3·59	...
,,	Cullompton	4·99	221	*Glam*	Cardiff, Ely P. Stn.	4·56	147
,,	Sidmouth, Sidmount	4·41	192	,,	Treherbert. Tynywaun	9·56	...
,,	Filleigh, Castle Hill	5·96	...	*Carm*	Carmarthen Friary	5·92	171
,,	Barnstaple. N. Dev. Ath.	4 85	180	,,	Llanwrda	7·20	177
Corn	Redruth, Trewirgie	6·69	214	*Pemb*	Haverfordwest, School	6·51	183
,,	Penzance, Morrab Gdn.	5·74	196	*Card*	Aberystwyth	4·61	...
,,	St. Austell, Trevarna	6·73	211	,,	Cardigan, County Sch.	4·59	...
Soms	Chewton Mendip	4·58	149	*Brec*	Crickhowell, Talymaes	6·30	...
,,	Long Ashton	4·24	...	*Rad*	BirmW. W. Tyrmynydd	7·96	206
,,	Street, Millfield	3·24	...	*Mont*	Lake Vyrnwy	6·94	196
Glos.	Cireneester, Gwynfa	3·58	163	*Denb*	Llangynhafal	2·69	...
Here	Ross, Birchlea	3·49	182	*Mer*	Dolgelly, Bryntirion	4·95	116
,,	Ledbury, Underdown	3·27	171	*Carn*	Llandudno	2·81	123
Salop	Church Stretton	3·88	191	,,	Snowdon, L. Llydaw 9	14.15	...
,,	Shifnal, Hatton Grange	3·09	160	*Ang*	Holyhead, Salt Island	3·14	117
Worc	Ombersley, Holt Lock	3·51	198	,,	Lligwy	2·77	...
,	Blockley	3·40	..	*Isle of Man*			
War	Farnborough	3·99	187		Douglas, Boro' Cem.	6·30	193
,,	Birminghm, Edgbaston	4·01	224	*Guernsey*			
Leics	Thornton Reservoir	4·02	222		St. PeterP't. GrangeRd.	3·57	137

Rainfall: September, 1930: Scotland and Ireland

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Wigt.	Pt. William, Monreith	4·44	...	*Suth*	Loch More, Achfary...	4·76	83
,,	New Luce School......	4·04	...	*Caith*	Wick......................	3·87	155
Kirk	Carsphairn, Shiel.......	6·70	...	*Ork*	Pomona, Deerness......	4·43	153
Dumf.	Dumfries, Crichton, R.I	2·79	109	*Shet*	Lerwick	3·22	107
,,	Eskdalemuir Obs.........	4·23	114	*Cork*	Caheragh Rectory......	5·04	...
Roxb	Branxholm	3·52	157	,,	Dunmanway Rectory...	5·08	124
Selk	Ettrick Manse...........	3·91	...	,,	Ballinacurra.............	4·97	197
Peeb	West Linton............	3·40	...	,,	Glanmire, Lota Lo......	5·39	192
Berk	Marchmont House......	4·49	186	*Kerry.*	Valentia Obsy..........	4·79	116
Hadd.	North Berwick Res.....	3·33	159	,,	Gearahameen............	8·80	...
Midl	Edinburgh, Roy. Obs.	4·16	221	,,	Killarney Asylum......	5·01	140
Ayr	Kilmarnock, Agric. C.	2·75	90	,,	Darrynane Abbey.......	4·54	127
,,	Girvan, Pinmore..	5·52	148	*Wat*	Waterford, Brook Lo...	3·87	140
Renf	Glasgow, Queen's Pk. .	5·48	198	*Tip*	Nenagh, Cas. Lough...	3·51	125
,,	Greenock, Prospect H.	4·58	97	,,	Roscrea, Timoney Park	3·61	...
Bute	Rothesay, Ardencraig.	4·65	115	,,	Cashel, Ballinamona...	3·46	141
,,	Dougarie Lodge.........	4·03	...	*Lim*	Foynes, Coolnanes......	3·75	130
Arg	Ardgour House	6·75	...	,	Castleconnel Rec.......	3·93	...
,,	Manse of Glenorchy...	5·04	...	*Clare*	Inagh, Mount Callan...	4·67	...
,,	Oban......................	3·40	...	,,	Broadford, Hurdlest'n.	3·48	...
,,	Poltalloch	3·83	84	*Wexf.*	Gorey, Courtown Ho...	5·38	218
,,	Inveraray Castle...	5·56	87	*Kilk*	Kilkenny Castle.........	3·63	157
,,	Islay, Eallabus.........	3·66	87	*Wic*	Rathnew, Clonmannon	5·50	...
,,	Mull, Benmore.........	12·40	...	*Carl*	Hacketstown Rectory..	6·05	216
,,	Tiree	2·72	...	*Leix*	Blandsfort House......	3·92	144
Kinr	Loch Leven Sluice......	4·54	176	,,	Mountmellick...........	4·05	...
Perth	Loch Dhu...............	5·60	98	*Off'ly*	Birr Castle..............	3.86	168
,,	Balquhidder, Stronvar	5·33	...	*Kild'r.*	Monasterevin	4·02	...
,,	Crieff, Strathearn Hyd.	4·60	161	*Dubl*	Dublin, FitzWm. Sq...	6·87	357
,,	Blair Castle Gardens...	3·68	155	,,	Balbriggan, Ardgillan.	5·76	283
,,	Glen Bruar, Bruar Ldg.	5·61	...	*Me'th*	Beauparc, St. Cloud...	4·78	...
Angus.	Kettins School.	3·76	189	,,	Kells, Headfort.........	4·64	174
,,	Dundee, E. Necropolis	4·69	225	*W.M*	Moate, Coolatore......	3·14	...
,,	Pearsie House...........	5·47	...	,,	Mullingar, Belvedere..	4·67	175
,,	Montrose, Sunnyside...	4·76	239	*Long*	Castle Forbes Gdns......	3·52	122
Aber	Braemar, Bank...	5·53	220	*Gal*	Ballynahinch Castle...	7·60	159
,,	Logie Coldstone Sch....	6·07	261	,,	Galway, Grammar Sch.	3·31	...
,,	Aberdeen, King's Coll.	4·53	204	*Mayo*	Mallaranny..............	4·64	...
,,	Fyvie Castle.............	5·64	...	,,	Westport House.........	3·96	112
Moray.	Gordon Castle...........	4·62	185	,,	Delphi Lodge............	9·05	...
,,	Grantown-on-Spey......	4·24	171	*Sligo*	Markree Obsy............	4·01	120
Nairn.	Nairn, Delnies	3·04	138	*Cav'n.*	Belturbet, Cloverhill...	3·20	129
Inv	Kingussie, The Birches	3·58	...	*Ferm*	Enniskillen, Portora...	2·46	...
,,	Loch Quoich, Loan.....	8·31	...	*Arm*	Armagh Obsy............	3·00	122
,,	Glenquoich	6·88	80	*Down.*	Fofanny Reservoir......	6·73	...
,,	Inverness, Culduthel R.	3·07	...	,,	Seaforde.................	4·34	158
,,	Arisaig, Faire-na-Squir	3·68	...	,,	Donaghadee, C. Stn...	3·63	152
,,	Fort William...........	5·17	...	,,	Banbridge, Milltown...	3·36	...
,,	Skye, Dunvegan........	3·98	...	*Antr*	Belfast, Cavehill Rd...	4·84	...
R & C.	Alness, Ardross Cas ...	3·33	114	,,	Glenarm Castle.........	4·19	...
,,	Ullapool	3·23	...	,,	Ballymena, Harryville	3·07	99
,,	Torridon, Bendamph...	5·37	77	*Lon*	Londonderry, Creggan	2·89	88
,	Achnashellach..........	3·94	...	*Tyr*	Donaghmore	2·89	...
,,	Stornoway...............	2·79	71	,,	Omagh, Edenfel.........	2·94	96
Suth	Lairg.....................	2·87	...	*Don*	Malin Head..............	2·70	...
,,	Tongue	2·63	83	,,	Dunfanaghy.............	2·19	...
,,	Melvich..................	...	...	,,	Killybegs, Rockmount.	3·73	81

Climatological Table for the British Empire, April, 1930.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb							
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1009·1	— 5·3	68	31	53·2	40·8	47·0	— 0·3	43·1	86	8·1	1·87	+ 0·42	14	3·5	25
Gibraltar	1012·6	— 3·9	71	47	65·5	51·8	58·7	— 2·3	51·9	85	6·0	4·52	+ 1·84	17	..	..
Malta	1011·0	— 3·0	79	47	65·4	54·1	59·7	— 1·2	55·1	77	5·3	0·82	— 0·04	6	9·0	69
St. Helena	1013·7	+ 0·8	..	58	..	60·3	..	..	61·5	94	9·2	4·57	+ 0·70	24	..	..
Sierra Leone	1012·7	+ 1·9	88	69	86·5	73·5	80·0	— 2·4	74·3	77	5·3	0·57	— 3·49	4	..	..
Lagos, Nigeria	1009·6	— 0·2	92	71	88·5	76·4	82·5	0·0	78·5	81	8·1	5·01	— 0·74	9	..	..
Kaduna, Nigeria	1013·9	+ 2·2	99	66	93·4	70·9	82·1	+ 0·6	72·2	66	1·0	1·25	— 2·04	5	..	..
Zomba, Nyasaland	1011·6	— 0·9	82	54	76·0	62·6	69·3	0·0	..	83	7·6	2·43	— 1·23	11	..	..
Salisbury, Rhodesia	1011·6	— 0·8	81	43	76·4	56·0	66·2	+ 0·5	58·8	66	4·3	0·23	— 0·76	7	7·5	64
Cape Town	1017·1	+ 0·8	88	43	73·8	52·8	63·3	+ 0·1	55·4	89	5·3	0·93	— 0·94	5	..	..
Johannesburg	1016·0	— 0·8	77	35	70·4	50·2	60·3	+ 0·5	50·2	57	2·7	0·52	— 1·22	7	8·7	76
Mauritius	1011·5	— 2·5	87	62	83·3	69·4	76·4	+ 0·6	72·0	68	4·8	1·34	— 3·13	11	8·1	70
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	2·17	+ 0·04	..	..	..
Calcutta, Alipore Obsy.	1006·6	+ 0·3	107	70	97·7	77·1	87·4	+ 1·7	75·9	74	3·0	0·11	— 1·78	0*	..	..
Bombay	1008·1	— 0·7	95	73	90·0	76·5	83·3	+ 0·2	75·0	72	1·4	0·00	— 0·05	0*	..	..
Madras	1008·1	— 0·3	101	73	92·8	77·2	85·0	— 0·3	78·5	74	4·7	0·00	— 0·53	0*	..	..
Colombo, Ceylon	1009·0	— 0·1	91	73	88·8	75·6	82·2	— 0·4	78·4	74	6·7	13·52	+ 5·22	17	8·0	65
Hongkong	1011·7	— 1·0	85	63	77·4	70·6	74·0	+ 3·2	70·6	86	8·1	2·10	— 3·20	9	4·7	37
Sandakan	..	..	92	74	89·4	75·9	82·7	+ 0·4	78·0	79	..	2·13	— 1·94	6	..	..
Sydney, N.S.W.	1019·2	+ 0·7	85	50	69·7	56·4	63·1	— 1·6	57·8	71	5·3	4·87	— 0·70	13	6·6	58
Melbourne	1020·1	+ 0·7	82	40	68·4	48·4	58·4	— 1·1	52·4	64	6·1	1·75	— 0·50	11	6·4	58
Adelaide	1020·0	0·0	89	50	75·6	55·6	65·6	+ 1·7	55·9	50	5·1	0·97	— 0·78	11	6·8	61
Perth, W. Australia	1016·7	— 1·8	89	48	77·2	57·9	67·5	+ 0·9	58·8	58	4·6	2·29	+ 0·71	7	7·0	62
Coolgardie	1017·5	— 1·0	90	42	74·2	52·1	63·1	— 2·0	56·1	62	4·5	2·91	+ 1·96	8	..	..
Brisbane	1017·4	— 0·2	84	55	77·7	59·9	68·8	— 1·5	62·3	66	4·7	2·25	— 1·34	9	7·3	64
Hobart, Tasmania	1018·0	+ 3·5	78	37	60·9	47·7	54·3	— 0·8	49·5	74	6·9	2·01	+ 0·12	16	4·1	38
Wellington, N.Z.	1021·0	+ 2·9	70	40	62·7	50·0	56·3	— 0·6	52·8	75	6·1	3·86	— 0·02	6	6·1	55
Suva, Fiji	1012·0	+ 1·4	89	69	85·5	72·7	79·1	+ 0·4	74·9	78	5·7	6·46	— 4·82	17	7·0	60
Apia, Samoa	1009·1	— 0·8	87	71	85·7	74·4	80·1	+ 1·2	77·6	77	4·8	10·32	+ 0·08	15	7·2	61
Kingston, Jamaica	1013·6	— 0·5	90	67	85·8	70·2	78·0	— 0·4	69·7	84	3·9	1·18	— 0·06	6	7·7	62
Grenada, W.I.	1010·4	— 2·0	90	72	87·1	73·5	80·3	+ 1·4	74·1	78	3·7	2·00	— 0·28	15	..	..
Toronto	1016·8	+ 1·3	71	25	51·0	34·7	42·9	+ 1·5	35·6	63	5·7	1·23	— 1·17	8	6·0	45
Winnipeg	1017·4	+ 0·4	71	17	53·7	32.9	43·3	+ 5·5	..	..	5·2	0·53	— 0·96	6	7·6	55
St. John, N.B.	1013·9	+ 0·3	58	17	46·8	30·4	38·6	— 0·4	33·9	65	5·1	1·90	— 1·61	12	6·9	51
Victoria, B.C.	1015·2	— 2·1	65	38	56·9	44·1	50·5	+ 2·8	47·2	78	6·9	1·00	— 0·73	8	6·1	45

Climatological Table for the British Empire, April, 1930.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1009·1	− 5·3	68	31	53·2	40·8	47·0	− 0·3	43·1	86	8·1	1·87	+ 0·42	14	3·5	25
Gibraltar	1012·6	− 3·9	71	47	65·5	51·8	58·7	− 2·3	51·9	85	6·0	4·52	+ 1·84	17	..	..
Malta	1011·0	− 3·0	79	47	65·4	54·1	59·7	− 1·2	55·1	77	5·3	0·82	− 0·04	6	9·0	69
St. Helena	1013·7	+ 0·8	..	58	..	60·3	..	..	61·5	94	9·2	4·57	+ 0·70	24	..	..
Sierra Leone	1012·7	+ 1·9	88	69	86·5	73·5	80·0	− 2·4	74·3	77	5·3	0·57	− 3·49	4	..	..
Lagos, Nigeria	1009·6	− 0·2	92	71	88·5	76·4	82·5	0·0	78·5	81	8·1	5·01	− 0·74	9	..	..
Kaduna, Nigeria	1013·9	+ 2·2	99	66	93·4	70·9	82·1	+ 0·6	72·2	66	1·0	1·25	− 2·04	5	..	..
Zomba, Nyasaland	1011·6	− 0·9	82	54	76·0	62·6	69·3	0·0	..	83	7·6	2·43	− 1·23	11	..	..
Salisbury, Rhodesia	1011·6	− 0·8	81	43	76·4	56·0	66·2	+ 0·5	58·8	66	4·3	0·23	− 0·76	7	7·5	64
Cape Town	1017·1	+ 0·8	88	43	73·8	52·8	63·3	+ 0·1	55·4	89	5·3	0·93	− 0·94	5	..	..
Johannesburg	1016·0	− 0·8	77	35	70·4	50·2	60·3	+ 0·5	50·2	57	2·7	0·52	− 1·22	7	8·7	76
Mauritius	1011·5	− 2·5	87	62	83·3	69·4	76·4	+ 0·6	72·0	68	4·8	1·34	− 3·13	11	8·1	70
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	2·17	+ 0·04	..	..	..
Calcutta, Alipore Obsy.	1006·6	+ 0·3	107	70	97·7	77·1	87·4	+ 1·7	75·9	74	3·0	0·11	− 1·78	0*	..	..
Bombay	1008·1	− 0·7	95	73	90·0	76·5	83·3	+ 0·2	75·0	72	1·4	0·00	− 0·05	0*	..	..
Madras	1008·1	− 0·3	101	73	92·8	77·2	85·0	− 0·3	78·5	74	4·7	0·00	− 0·53	0*	..	..
Colombo, Ceylon	1009·0	− 0·1	91	73	88·8	75·6	82·2	− 0·4	78·4	74	6·7	13·52	+ 5·22	17	8·0	65
Hongkong	1011·7	− 1·0	85	63	77·4	70·6	74·0	+ 3·2	70·6	86	8·1	2·10	− 3·20	9	4·7	37
Sandakan	..	..	92	74	89·4	75·9	82·7	+ 0·4	78·0	79	..	2·13	− 1·94	6	..	..
Sydney, N.S.W.	1019·2	+ 0·7	85	50	69·7	56·4	63·1	− 1·6	57·8	71	5·3	4·87	− 0·70	13	6·6	58
Melbourne	1020·1	+ 0·7	82	40	68·4	48·4	58·4	− 1·1	52·4	64	6·1	1·75	− 0·50	11	6·4	58
Adelaide	1020·0	0·0	89	50	75·6	55·6	65·6	+ 1·7	55·9	50	5·1	0·97	− 0·78	11	6·8	61
Perth, W. Australia	1016·7	− 1·8	89	48	77·2	57·9	67·5	+ 0·9	58·8	58	4·6	2·29	+ 0·71	7	7·0	62
Coolgardie	1017·5	− 1·0	90	42	74·2	52·1	63·1	− 2·0	56·1	62	4·5	2·91	+ 1·96	8	..	..
Brisbane	1017·4	− 0·2	84	55	77·7	59·9	68·8	− 1·5	62·3	66	4·7	2·25	− 1·34	9	7·3	64
Hobart, Tasmania	1018·0	+ 3·5	78	37	60·9	47·7	54·3	− 0·8	49·5	74	6·9	2·01	+ 0·12	16	4·1	38
Wellington, N.Z.	1021·0	+ 2·9	70	40	62·7	50·0	56·3	− 0·6	52·8	75	6·1	3·86	− 0·02	6	6·1	55
Suva, Fiji	1012·0	+ 1·4	89	69	85·5	72·7	79·1	+ 0·4	74·9	78	5·7	6·46	− 4·82	17	7·0	60
Apia, Samoa	1009·1	− 0·8	87	71	85·7	74·4	80·1	+ 1·2	77·6	77	4·8	10·32	+ 0·08	15	7·2	61
Kingston, Jamaica	1013·6	− 0·5	90	67	85·8	70·2	78·0	− 0·4	69·7	84	3·9	1·18	− 0·06	6	7·7	62
Grenada, W.I.	1010·4	− 2·0	90	72	87·1	73·5	80·3	+ 1·4	74·1	78	3·7	2·00	− 0·28	15	..	..
Toronto	1016·8	+ 1·3	71	25	51·0	34·7	42·9	+ 1·5	35·6	63	5·7	1·23	− 1·17	8	6·0	45
Winnipeg	1017·4	+ 0·4	71	17	53·7	32.9	43·3	+ 5·5	..	..	5·2	0·53	− 0·96	6	7·6	55
St. John, N.B.	1013·9	+ 0·3	58	17	46·8	30·4	38·6	− 0·4	33·9	65	5·1	1·90	− 1·61	12	6·9	51
Victoria, B.C.	1015·2	− 2·1	65	38	56·9	44·1	50·5	+ 2·8	47·2	78	6·9	1·00	− 0·73	8	6·1	45

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

M.O. 326.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 65
Nov., 1930
No. 778

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:
ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH;
YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 15, DONEGALL
SQUARE WEST, BELFAST; or through any Bookseller.

Maurice Alfred Giblett, M.Sc., 1894-1930

Life is the most precious possession of man; yet there are those who are ready to risk it for a high ideal. Religion, patriotism, affection, knowledge, are all ideals which at times demand the decision to put life to the hazard and we honour to the full those who accept the risk for the sake of the ideal. A long sequence of names of those who have taken the risk and lost flashes into one's mind. These are the names which we honour above all others, the names we quote with pride of race, the names we teach our children as examples. To that long list we have now to add the name of our colleague and friend, M. A. Giblett, who lost his life when on meteorological duty in the ill-fated airship R 101.

During the last six years Giblett has devoted his life to the study of the atmosphere as the highway of the airship. His ideal was to make the atmosphere the servant of the airship and not its master. This is not a rhetorical phrase, but a simple statement of the objects of his endeavour. He saw quite clearly that an airship could not, like a train or even an aeroplane, go straight ahead and conquer the air by superior force. He saw that on occasion the airship would have to submit to the winds, but he also saw that with sufficient knowledge the winds could be used to help the ship: this of course was common knowledge, something which we all knew, but to Giblett it was something more than knowledge—it was something he had to do.

(91727) P.S.14/89 1,050 11/30 M. & S. Gp.303

S. P. Andrews, Photographer.

Maurice Alfred Giblett, M.Sc., 1894-1930.

For six years he worked indefatigably on the problem. By a laborious study of past weather he worked out the best world tracks for airship lines and in co-operation with the navigators of the airship he examined how to navigate the airship along these lines so as to make the best use of the wind currents as they changed from day to day. He organised a wonderful system for the transmission of weather information to the airship by wireless and taught the navigators of the ship how to use the information received. He studied thunderstorms, line squalls and waterspouts in order to estimate their danger and how to circumnavigate them.

It is not, however, my object in this short note to describe Giblett's work, but to put on record the spirit in which he worked. With a devoted band of workers at Cardington, Giblett literally wrapped himself up in his work for airships. He had little or no time for outside interests; but with a single purpose devoted himself to perfecting the meteorological organisation on which, he was firmly convinced, the success of airship transport would ultimately depend. It was never intended that Giblett should be the meteorological officer to accompany the airships; but he felt that in the initial stages, while the organisation he had built up was being tried out, his proper place was on the airships. He therefore obtained permission to accompany each airship on its trial and first overseas flights.

He knew, of course, that there was risk, especially on these early flights; but his enthusiasm for his work was so great that he was prepared to accept the risk as being all in the day's work. This was the attitude of everyone who took part in the fatal flight and one feels confident that each would have said exactly the same as Captain Scott said in similar circumstances: "We took risks, we knew we took them; things have come out against us, and therefore we have no cause for complaint, but bow to the will of Providence, determined still to do our best to the last."

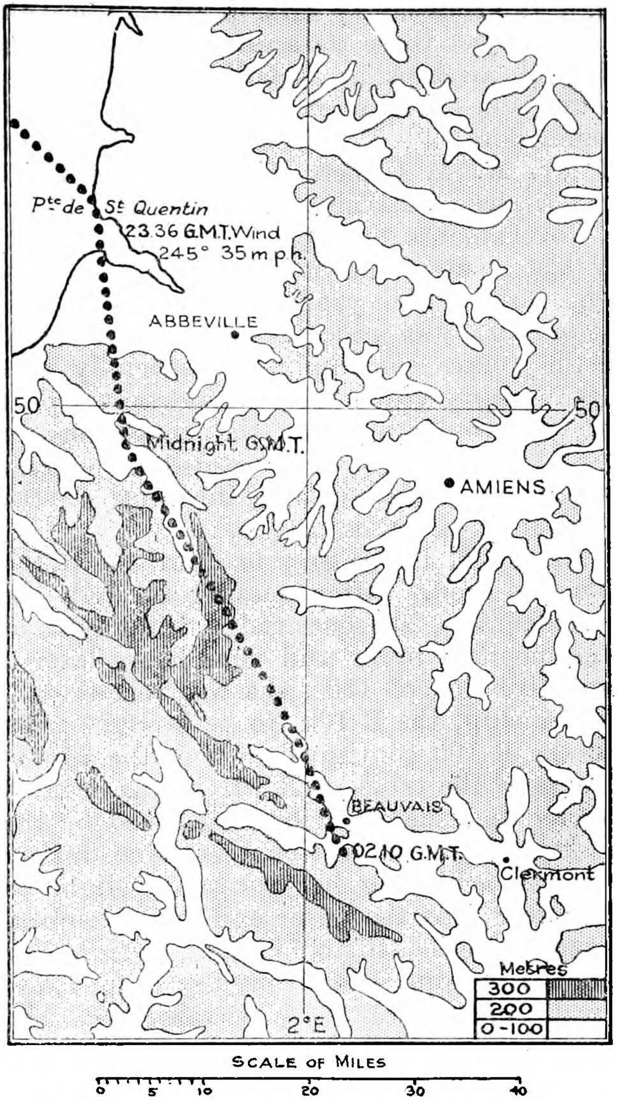
The Meteorological Office has lost an assistant of whom great things were expected, an able scientist and an exceptional organiser; his colleagues have lost a friend, but his mother, wife and daughter have lost much more, and it is to them that our thoughts go out with the deepest sympathy; may the knowledge of the high esteem and affection in which he was held comfort them in their grief. G. C. SIMPSON.

The Loss of the R 101

The programme under which the two airships R 100 and R 101 were built was initiated by Mr. Ramsay MacDonald's Government in 1924, the general concept of that programme being a far-sighted one of the eventual linking of the whole Empire by airship routes, but while this was the ultimate aim the first step was primarily the establishment of airship communication with India, and with this object there were established mooring towers for the handling of airships at Ismailia and Karachi. Among other preliminary steps a mission consisting of Group Captain (now Air Commodore) P. F. M. Fellowes, Squadron Leader S. Nixon and Mr. M. A. Giblett was sent in 1927 to the Dominions of South Africa, Australia and New Zealand to advise the Dominion Governments on sites for airship bases. On the way back they also visited and inspected Karachi and Ismailia. In addition, during the years between 1924 and 1930 a very great deal of work was undertaken in the meteorological exploration of the routes contemplated, especially that leading to India, for it was early realised how important a part meteorological information would play in the operations of airships. The building of the ships, too, proceeded with great thoroughness and some considerable delays inherent to the development of many novel features in design.

At last, on October 12th, 1929, in the grey of dawn the R.101 was first launched from her shed. After passing through her trials, during which incidentally, she endured a wind gust of 83 miles per hour at the mooring tower and some hours later a very rapid veer in wind direction of 135°, she was rehoused in her shed to allow her sister ship, the R 100, to be brought from Howden. The trials of the R 100 continued during the winter and spring. On the results of the trials of R 101 it was decided that the ship was so strong that she could be lengthened by the addition of a bay amidships. This alteration was made during the period when R 100 was achieving her successful flight to Canada in August of this year. At the latter end of September, R 101 was once more ready, lengthened to 777 feet, with a new outer cover and with new reversing Diesel engines (a problem that had presented great difficulties). On October 1st, she started for a 16 hours' trial, returning the morning of the next day, and to those who saw her manœuvring on that trial, she seemed one of the most beautiful and graceful things that man had made.

The start for India was planned for the evening of Saturday, October 4th, the evening being chosen that she might start in the cool of the day when her lift would be greatest and that she might have night conditions for navigating across northern France when her load would be greatest. Two main routes were open to her, by Dijon and the Rhone Valley or to westward of the French Central Massif and so to the southern French coast to northward of the Pyrenees. While before her start it was anticipated that the latter route would be chosen, the final decision was not to be made till after Paris had been reached. The time of her departure originally fixed for 6 p.m. (B.S.T.) was postponed by an hour. Before that time a small crowd had assembled at the foot of the mooring tower, enviously bidding good-bye to their friends and watching the bustle of final preparations. Seven o'clock came and with it dusk began to fall. Engine after engine sputtered and purred in the last test. There was difficulty with the forward port engine, one of the newest type and the only one in which petrol was entirely eliminated by even the starting engine being driven by heavy oil, but the trouble was only with the starting engine and after a delay of some twenty minutes that, too, took up its tale.


Pte de St Quentin
23.36 G.M.T. Wind 245° 35 m.p.h.
ABBEVILLE
50
50
Midnight G.M.T.
AMIENS
BEAUVAIS
02.10 G.M.T.
Clermont
Metres
300
200
0-100
2°E
Scale of Miles
0
5
10
20
30
40

THE SCENE OF THE DISASTER TO H.M. AIRSHIP R 101, OCTOBER 5TH, 1930.

The course of the ship is indicated by the broken line joining reported positions.

Darkness had fallen. In the brightly-lit passengers' saloon could be seen figures waving farewell. She cast off. A lamp in the control car flicked a last message. The first drops of the approaching rain spattered the onlookers. The ship bore up into the wind and circled over Bedford, then made her course south for London.

The story of her flight is best told in the messages she sent:—

9.21 p.m. (B.S.T.)—Over London, moderate rain, base of low cloud, 1,500ft.; wind, 240°, 25 m.p.h.; course now set for Paris.

Intend to proceed via Paris, Tours, Toulouse and Narbonne.

10.47 p.m. At 10.35 crossing coast in vicinity of Hastings. It is raining hard, and there is a strong south-westerly wind. Cloud base is at 1,500ft. After a good getaway from the mooring tower at 7.30, ship circled Bedford before setting course. Course was set for London at 7.54. Engines running well at cruising speed gave 54·2 knots (62 m.p.h.) Reached London at 9 o'clock, and then set course for Paris, gradually increasing height so as to avoid high land. Ship is behaving well generally, and we have already begun to recover water ballast.

12.36 a.m. Crossing French coast at Pointe de St. Quentin; wind 245° true, 35 m.p.h.

1 a.m.—15 miles south of Abbeville, course and speed made good from 7.30 various, 33 knots (38 m.p.h.); altimeter height, 1,500ft.; air temperature, 51°; intermittent rain;cloud, nimbus at 500ft.; conditions since departure similar; temperature uniform. After an excellent supper our distinguished passengers smoked a final cigar, and, having sighted the French coast, have now gone to bed to rest after the excitement of their leave-takings. All essential services are functioning satisfactorily. The crew have settled down to watchkeeping routine.

At about 1.50 G.M.T. she was heard getting her position from Le Bourget which was given her as one kilometre north of Beauvais. She was heard to thank Le Bourget and say she was going on to another wave length, presumably to pick up the 2 o'clock synoptic weather message from the Air Ministry. At 2.10 she struck the hillside about four miles south of Beauvais.

The evidence as to what occurred during and immediately before the disaster is scanty and as is natural in an accident of this sort, some conflicting accounts have been published. Of the 54 on board only six were saved, four of whom were in the three aft engine cars and consequently were not so entirely trapped by the mass of the ship after the crash. The other two, Mr. H. J. Leech, foreman engineer, and Mr. A. Disley, one of the wireless operators, were at the time actually in the hull. From their accounts and those of people who were in the neighbourhood, it is clear that the ship gave two distinct steep dives before she struck the ground and between these dives, she returned to a level keel. An important statement is that of Mr. Disley who was warned by the Chief Coxswain, just before the ship entered the second dive, that the ship was doomed. In the second dive the ship struck the ground, the nose moving forward in a bound after the first impact. As it struck the second time there was a burst of flame and the whole ship became enveloped.

Others have written of the men who perished in her. To those who worked with them they were a compact unit, they saw a grand ideal and their determination and faith was, and is, infectious. Perhaps Sir Samuel Hoare best epitomises their qualities when, after alluding to Lord Thomson's fine mind and vivid enthusiasm and Sir Sefton Brancker, whose name stands most conspicuously for civil aviation in every country in the world, he says:—

"These were two notable personalities. The other victims were only now stepping upon the front of the stage, their names still to be established, their careers not yet consummated. Richmond, the subtle designer, who laboured well the minute particulars of every plan; Scott the fearless navigator, who had twice taken an airship across the Atlantic; Colmore, the quiet and tactful administrator who supervised the work of Cardington; Irwin, the captain of the ship, as brave in death as he had been steadfast in life; Johnston, who in the teeth of rain and sand and wind could keep a course as straight as a furrow; Giblett, the meteorologist, who with rare skill helped to chart the air between England and the East—these were the men who if they had lived would have stamped their achievements upon British history. I knew them well. For years we worked together. They were as a religious community intent upon a high ideal. Neither disappointment nor success deflected them from their life's work. When I talked with them at Cardington I knew that I was in the presence of determined men of set purpose. When I flew with them I marked the rare balance between brain and hand and eye that their airmanship displayed."

To this list may be added Rope, who as Richmond's right hand, solved many intricate problems of construction; Atherstone, the conscientious and thorough; Steff the cheerful.

C. S. Durst.

M. A. Giblett: His Life and Work

Maurice Alfred Giblett was born at Englefield Green, Surrey, on July 15th, 1894, and was educated at Upton School, Slough, and Modern School, Maidenhead. He received his University training at University College, Reading, from which he took his B.Sc. degree at London in 1914, with first-class honours in pure and applied mathematics. He afterwards completed two years' post-graduate work at East London College, University of London, taking his M.Sc. degree in mathematics later. In 1916 he joined the staff of H.M.S. *Worcester*, under Captain Sir David Wilson Barker, as instructor in meteorology and navigation. After completing a cadet course at the Royal Garrison Artillery Cadet School at Uckfield, he was commissioned in the Meteorological Section, Royal Engineers, in July, 1919, for service with the British Expeditionary Force in north Russia. On the withdrawal of the British Expedition he returned to England

and in October, 1919, was appointed a professional assistant in the Forecast Division of the Meteorological Office.

From the outset of his official career Giblett showed himself to be possessed of more than ordinary scientific ability and this, combined with a keen power of application, soon brought him into prominence. In 1922 he was appointed meteorological secretary of Section A of the British Association, a service which he performed with conspicuous success. It was characteristic of the man that after the meeting of the Association held in Toronto in 1924, he seized the opportunity which was offered him of visiting the Meteorological Service of Canada and the United States Weather Bureau establishments at Washington and New York in order to study their organisations. It may be mentioned in this connexion that he had been one of the first to realise the importance of the new ideas regarding the structure of depressions which had been developed in Norway during the war, and this had led to a close friendship between him and J. Bjerknes. While on the visit to America he carried out an investigation in collaboration with Bjerknes, who was also there on a visit, on the structure of a retrograde depression over the eastern United States of America, a piece of work which was published in the *Monthly Weather Review* in the same year. On the return voyage from America he again collaborated with his Norwegian colleague in demonstrating the practicability of weather forecasting at sea. This was accomplished by arranging for the ship's wireless station to pick up weather reports from other ships in addition to synoptic data from America or Europe, and drawing synoptic weather charts on board.

Another opportunity which offered itself during Giblett's period of service in the Forecast Division, was to participate in a cruise in the North Sea in the summer of 1921 on the research trawler *George Bligh*, belonging to the Ministry of Agriculture and Fisheries. During this cruise he carried out an investigation on the effect of the rolling of the ship on the readings of a standard Kew pattern marine barometer. The results of this investigation were afterwards published in a memoir in the *Philosophical Magazine*. Perhaps, however, Giblett's most important contribution to theoretical meteorology during this period of his career was a brilliant paper read before the Royal Society in 1921 on evaporation from large expanses of water, in which he applied recent knowledge regarding atmospheric turbulence to discussing the process by which the air obtains its supply of water vapour from the oceans and calculating the amount of evaporation which occurs in various conditions of wind speed and water surface temperature. His other contributions to meteorological literature about this time, while of a minor nature, were yet of a high order, consisting chiefly of analyses of atmospheric conditions associated with selected meteorological situations which he came across in the course of his official duties as a forecaster.

Giblett's association with airships began as early as 1921, when he was released temporarily from the Forecast Division and posted for duty in connexion with the trials of airships R 80, R 36 and R 38. His work on this service earned a warm expression of appreciation from Air Commodore Maitland, who was then in charge of airship organisation. When, in 1924 it was decided to revive the development of airships, Giblett, who had been promoted to the grade of Assistant Superintendent in the Forecast Division in 1922, was selected for the post of Superintendent of the Airships Services Division of the Meteorological Office, which was formed on January 1st, 1925, to study the special problems connected with the meteorological conditions affecting airship navigation, to investigate in detail the meteorological conditions along projected airship routes and to draw up an organisation for the supply of data and forecasts during airship operations. Giblett threw himself wholeheartedly into his new work and from the date of his appointment directed his entire energy to mastering the problems connected with meteorology and airship navigation.

Reference has been made already to Giblett's scientific ability and power of application. To these assets must be added two additional qualities which evinced themselves and stood him in good stead in his new work, namely, organising ability and personality. The former was evident in the masterly way in which he built up his local meteorological service at Cardington and developed the organisation which he visualized as essential to the operation of an Empire airship service, while the latter won for him from the outset the friendship and esteem of the Airship Staff at Cardington, with whom he had to work. Moreover, he was not satisfied with simply building up an organisation to meet the demands for meteorological data which, he knew, would be made on him, but he made it his business to become familiar with every aspect of airship design, mooring and operation in order that he might give the Airship Staff the best meteorological information possible. He became a definite part of the airship organisation at Cardington.

The first two years of the new Airship Services Division were devoted almost entirely to carrying out a programme of work for the investigation of meteorological conditions along proposed airship routes to Egypt and India, and the discussion of special conditions at projected airship bases. It is impossible in the space available to give a complete account of this investigational work, but it included a detailed study, not only of the average conditions along the routes and the special characteristics of the bases, but also of the general distribution of weather and wind on individual days and of the day-to-day changes. The latter was a remarkable piece of work, involving the preparation of a series of daily weather charts for the whole area embracing the route from England to India. From November, 1925, to January, 1926, Giblett was absent on a tour of duty in Malta, Egypt, Italy and France, when he investigated the sources of meteorological information which could be drawn upon for his investigations and also, when the time came for airship operations, for the meteorological reporting and forecasting organisation.

The Imperial Conference which was held in London in 1926 made further demands on Giblett's resources, for he was called upon to prepare a comprehensive memorandum on various aspects of meteorological work in relation to the development and operation of Empire airship services. This memorandum, which was characteristically complete and informative, was published in a book presented to the Conference by the Secretary of State for Air, and entitled " The Approach towards a System of Imperial Air Communications." As a result of the Conference it became necessary for Giblett to devote the greater part of his time to the consideration of questions concerning the probable future main airship routes to the various Dominions. He prepared comprehensive reports on the meteorological conditions in the vicinity of twenty-seven places in the areas within which the main Imperial airship routes could best be developed from the meteorological point of view. This work formed the basis of discussion with the Dominion authorities when, in 1927, the Air Ministry dispatched an Airship Mission in the charge of Group Captain P. F. M. Fellowes, Director of Airship Development, to visit South Africa, Australia, New Zealand and Ceylon, for the purpose of surveying possible sites for the erection of airship mooring towers. Giblett was a member of this Mission and in addition to acting in his capacity as technical adviser, he took every opportunity of obtaining further meteorological data and of discussing with the local authorities the meteorological ground organisation which would be required for the operation of airship services. He visited India and Egypt before returning to England.

From the foregoing brief, and far from complete, account of Giblett's activities during the years following his appointment as Superintendent of Airship Meteorological Services, it will be readily gathered that he had little time available for purely scientific work apart from his official duties. The latter, however, presented him with ample material for scientific investigation, and during this period he carried out several special pieces of work which had a bearing on the safety and operation of airships. Among these may be mentioned a report prepared in collaboration with Wing Commander T. R. Cave-Browne-Cave, of the Airship Staff, on "Selected records of upper air temperature and humidity in different localities with special reference to the maximum water recoverable from the exhaust gas of an airship in flight," a discussion of the magnitude of intense vertical atmospheric currents and of the winds in tornadoes and waterspouts and detailed investigations of special phenomena such as the destructive Persian Gulf cyclone of October, 1925, and a line squall at Malta in December, 1925, which was accompanied by waterspout phenomena. He also found time to make a detailed study of line squalls and waterspouts, and in March, 1927, read a paper before the Royal Aeronautical Society which probably contains the most complete account of the subject in existence, and which included certain new ideas on the structure of line squalls.

Mention must be made here of two pieces of full-scale research at airship bases which were initiated by Giblett. The first, which was commenced on behalf of the Aeronautical Research Committee, was an investigation into the detailed gustiness and rapid changes of the wind as affecting the problem of the mooring of large rigid airships, from both the design and the operational points of view. While the primary object of the research was to obtain data for these practical purposes, the results. which are not yet complete, promise to provide a great deal o new information of importance in theoretical meteorology since observations of such a detailed character have never formerly been attempted. Special anemometers recording the velocity and direction of the wind at a height of 50 feet above the ground were installed at Cardington at the corners of an equilateral triangle with sides 700 feet long, this being approximately the length of an airship, while a fourth anemometer was erected at the middle point of one of the sides. The anemometers were specially adapted so that records of the individual gusts were obtained on a very open time scale and the instruments were connected by an electrical timing system which enabled any fluctuation in the wind at any one position to be timed to a second and so permitted of accurate comparison between the records obtained on the different instruments. From the tabulation of the records eddies of different magnitude were sorted out and their horizontal extent in different directions, rate of movement and degree of persistence were studied. A second part of the research was devoted to a similar detailed examination of the rapid and almost instantaneous change from one general wind to another from a totally different direction such as occurs during the passage of a line squall. The research has already yielded certain striking and valuable results and when completed it will form a classical piece of meteorological literature.

The second investigation, which is being carried out at Ismailia, the airship base in Egypt, aimed at obtaining a continuous record of the temperature lapse rate during day and night in the first few hundred feet above the surface, this information being of fundamental importance in connexion with the problem of mooring airships in a hot climate. A special mast 200 feet high was erected near the site for the airship mooring tower and electrically recording thermometers were installed on the mast at various levels above the ground. This installation has already provided much valuable data.

By 1929 the two new airships R 100 and R 101 were nearing completion, and Giblett's attention was directed to perfecting his forecasting service which had been gradually built up at Cardington and to completing the details of the meteorological organisation along the airship route to India. The decision to send R 100 to Canada necessitated a new investigation into meteorological conditions over the Atlantic and Giblett devoted considerable time in the early part of 1930 to discussions with the airship officers on the times which would be taken by the airship to cross to Canada by various routes in different wind conditions.

By the time the airships were ready for their home trials, Giblett had his organisation complete in every detail. During the first trial flight and the endurance flights of each airship he obtained permission to be on board in an official capacity in order to see the organisation working at first hand, and to ensure that it was satisfactory. He would not leave anything to chance. When the R 100 made her flight to Canada and back, although he could have arranged for a member of his professional staff to go on the flight as meteorological officer, he himself filled this post and the information which he provided for the Captain and Navigator of the airship played no small part in the success of this experimental flight. He chose to accompany the ill-fated R 101 in a similar capacity and only a few days ago one of the survivors related at the Public Inquiry now being held into the loss of the airship, how, two hours before the disaster, he saw Giblett engaged in the control room in completing his weather chart which was to form the basis of the last advice he was to render in the service of airships.

Giblett lived for his work. Thoroughness was the keynote which marked it throughout his career. Whatever he undertook, whether of a major or minor nature, he was not satisfied unless he had put his best into it. Beloved by his staff at Cardington, he knew how to engender and encourage team work. Although his work meant so much to him, he could relax at the proper time, and it would have been difficult to find a more agreeable companion. By his untimely death those who knew him best have lost a loyal friend and devoted colleague, while the world has lost a brilliant scientist.

F. ENTWISTLE.

From the Meteorologists at Cardington

Of Mr. Giblett's scientific distinction others are better qualified to write, but the observing and wireless staff at the Meteorological Office, Cardington, who have worked with him in all the ups and downs of the past two or three years, think of him from a different angle.

He was so appreciative of everything we did, and his whole personality was so even and genial, that to work with him was a very real pleasure. Any service, big or small, was received with a quiet smile, a careful scrutiny, and always a word of thanks. Accuracy and neatness he expected to a high degree, but criticism of a completed task was rare, for he had the ability to explain exactly what he wanted before any work was commenced.

The Cardington Meteorological Office was his special pride, and we strove unceasingly to come up to the high standard expected of us. Our suggestions were welcomed and used, and the whole staff worked as a team. Whether during the strenuous days of airship operations, or the quieter atmosphere of investigations, everything revolved around our Superintendent. We were disciplined without being aware of it, for he inspired loyalty, and we in turn could rely on his strong backing. He was always willing to advise, though never interfering; ready for a joke in the lulls of high-pressure work, but never familiar; taking a share of night duty to help those whose time was full; never a hasty word; one of us, though unquestionably the leader, and continually spreading his intense zeal to all around.

We miss him at every turn. We valued his considerate knock and momentary pause before entering our room, but above all was his gift of appreciation. It falls to the lot of few to work under such a man, but we who did so will ever hold his memory in affectionate regard as the ideal chief, gentleman and friend.

It was the privilege of the writer to work closely with Mr. Giblett in his meteorological organisation for the flight of R 101 to India, and to spend the last afternoon with him going over final details before he went on board. We packed together the key charts, code cards, etc., for drawing charts *en route*, and tied up his flying kit in a rough parcel, sun helmet dangling on the side. With a few beautifully chosen words of thanks, and a firm shake of the hand, he left us.

Our thoughts were primarily of him while he and his comrades were being honoured in St. Paul's Cathedral by the highest of the British Empire; we stood in the lane at Cardington, within sight of the office, grouped round our deeply grieved Officer-in-Charge, to pay our last respects, and now hope for the day when sudden gusts of wind will not cut so sharply.

W. A. L. MARSHALL.

Messages of Condolence

Immediately that the disaster to the R 101 became generally known, many letters and telegrams of condolence were received in the Meteorological Office from all parts of the world. The majority of these referred specially to Mr. Giblett, and came from meteorologists at home and abroad who had met him in the course of his work and had become his friends. Messsages were received from the following:—

Major J. Agostinho, Director of the Serviço Meteorologico dos Açores, Ponta Delgada; Dr. B. N. Banerji, Meteorologist-in-Charge at Karachi, India; Mr. W. E. Benbow, Assistant Editor of the "Metal Industry"; Regierungsrat Dr. R. Benkendorff, Reichsverkehr-ministerium, Berlin; M. R. Bureau, Chief of the Service de Transmission, Office National Météorologique, Paris; Colonel J. Waley Cohen; M. le Général Delcambre, Director of the Office National Météorologique, Paris; the Deutsche Seewarte; Dr. G. M. B. Dobson; Baron A. de Dorlodot, Brussels; Professor E. van Everdingen, Director of the K. Nederlandsch Meteorologisch Instituut, De Bilt; M. A. Gião, Institut Royal Météorologique, Brussels; Geheimrat Prof. Dr. H. Hergesell, Director of the Preussisches Aeronautisches Observatorium, Lindenberg; Mr. H. A. Hunt, Commonwealth Meteorologist, Australia; the Indian Meteorological Department; Dr. K. Keil, Leitung des Flugwetterdienstes, Berlin; Dr. D. la Cour, Director of the Dansk Meteorologisk Institut, Copenhagen; Dr. F. Linke, Director of the Universitäts-Institut für Meteorologie und Geodynamik, Frankfurt-am-Main; Rev. R. M. B. Mackenzie; Dr. C. F. Marvin, Chief of the United States Weather Bureau, Washington; Dr. C. W. B. Normand, Director-General of Observatories, Poona, India; Mr. J. Patterson, Director of the Canadian Meteorological Service; Sir Richard Redmayne, President of the Institution of Professional Civil Servants; Mr. P. J. G. Rose, Assistant Under-Secretary of State for Scotland; Sir Napier Shaw; Mr. C. D. Stewart, Malayan Meteorological Service, Kuala Lumpur; and Dr. G. Swoboda, Deutscher naturwissenschaftlich-medizinischer Verein, Prague.

Extracts from some of these messages follow:—

Major J. Agostinho.

"The destruction of the airship R 101 and the loss of so many lives is the cause of our most deep regret. I beg to convey the expression of our profound concern for the death of the Superintendent of the Airship Meteorology Division."

W. E. Benbow, Esq.

"I knew him years ago as a brilliant and enthusiastic mathematician. At that time (1916) he was on the staff of Dartford Grammar School, and those whom he taught will not soon forget his aptitude for making hard things easy. For myself, I owe what mathematical skill I have to his patient tuition."

Regierungsrat Dr. R. Benkendorff (addressed to Captain Entwistle).

"I learn to-day that in the deplorable accident to the R 101 your colleague—I may, I hope, say our colleague—met his death. In this great loss which English meteorology and in particular aeronautical meteorology has suffered, please accept my most sincere sympathy and that of us all.

I often thought during the war, how beautifully they die, who fall in the moment of attack, the summit of endeavour. So it was with Giblett. Just when he could translate into action the knowledge which he had gained, in the consummation of his strenuous labour, on the flight to which he had doubtless for long looked forward, death overtook him. This is indeed but poor comfort for the loss of the man himself."

M.R. Bureau (addressed to Captain Entwistle).

"Jusqu'aux journaux de ce matin qui publient la liste des victimes du R 101, j'avais conservé l'espoir—si faible fut-il—qu'un événement aurait empêché Giblett de monter à bord. Il me faut bien maintenant me rendre a l'évidence. Croyez à la part bien profonde qui je prends aujourd'hui au deuil du Meteorological Office au milieu du grand deuil britannique. En Giblett, c'est aussi un ami que je perds."

Colonel J. Waley Cohen.

"May I venture to offer you and through you to all your staff my most sincere sympathy on the loss of your airship colleague. Giblett was always such a pleasant and delightful person to work with that I fully realise what a loss he must be to you all, apart from his great experience."

Baron Albert de Dorlodot (addressed to Captain Entwistle).

"I have just heard from London the full list of casualties in the R 101. All day, I hoped Giblett might not have been on board. Now I know and I wish to offer you my deepest sympathy. I have always imagined you and Giblett were brothers, so much you carried out well together and I realise how much you must feel the tragic loss of one of the very best of men.

Will you please offer my profound sympathy to Dr. Simpson and tell him that the death of Mr. Giblett is felt in services abroad as in the British service. By his technical ability and by his personal charm, he made friends of all he met."

M. le Général Delcambre.

"Veuillez agréer l'expression de la vive et douloureuse sympathie de l'Office National Météorologique de France pour l'épouvantable malheur qui vient de frapper nos camarades de l'Aéronautique Britannique.

Mes collaborateurs Bureau et Wehrle et moi-même ne pensons pas sans une profonde tristesse à nos camarades et amis Brancker et Giblett qui ont trouvé une fin si tragique sur le sol de France où nous avions tant de joie à les rencontrer."

Mr. H. A. Hunt.

" I desire to express the deep sorrow and sympathy of myself and officers of this Bureau at the tragic death of Mr. M. A. Giblett, M.Sc., through the R 101 airship disaster."

Dr. K. Keil (addressed to Colonel Gold).

" My colleagues in the German aviation weather service and I were deeply shocked yesterday at the dreadful news of the terrible disaster to the British airship R 101. We desire to express our deepest sympathy with you and the Meteorological Office which has also lost a colleague in this disaster."

Dr. D. La Cour.

" I scarcely know how to express my deep feeling of grief learning this morning the sad news of the disaster of the British airship R 101. But I know that this airship marked important steps forward on the way of mankind."

Dr. F. Linke, Frankfurt-am-Main (addressed to Dr. Simpson).

" At mid-day to-day I heard the broadcast of the memorial service for the unfortunate crew of the R 101 and I feel compelled to do what I intended to do last Sunday, namely, to write and tell you of the universal mourning in Germany.

I know that in many circles in England the heart of the German people is misjudged, and there might be Englishmen who think that there was malignant joy in Germany. There was not a trace of it. Everybody recognised the sad tragedy that the first airship which was to have linked up two of the most important parts of the British Empire was a victim to *force majeure*.

Doubtless you knew those who died in England's service personally, therefore you have double grounds for mourning. I should like to assure you that I and all your other German friends sympathise with you."

Dr. C. F. Marvin (cabled).

" Weather Bureau staff expresses deep regret at loss of R 101 and its brave officials and crew. Death of Giblett, Scott and others is irreparable loss to meteorology and aerial navigation."

Dr. C. W. B. Normand.

"It was a great blow to read of the disaster to R 101. . . . . . I could picture to a small extent the awful shock of the news to Cardington, to the officers' homes there and to the workers. I had met most of the officers and was looking forward to seeing them again at Karachi. Poor Giblett! He had worked unsparingly for several years for airship meteorology, he had both scientific and business capacity and was one of the most promising of British meteorologists. We were very sorry to read about his loss, as well as of the others. I could see that the news was a real grief to my Indian officers and staff also.

The Karachi Meteorological Office had shifted out to a camp at the airship mast and had their organisation working satisfactorily there. Enthusiasm was high—but suddenly and tragically ended when the news came through."

Sir Richard Redmayne.

"I should like to express the deep sympathy of the Institution of Professional Civil Servants in the great loss you have sustained in the R 101 disaster in the death of Mr. M. A. Giblett, who was a member of the Institution. I am sure that at the Air Ministry you must feel completely crushed by the loss both of many personal friends, and of so much irreplaceable talent."

P. J. G. Rose, Esq.

"Like everyone else I am terribly grieved at the disaster to R 101 and I am specially grieved at the loss of your brilliant assistant, Mr. Giblett, who has rendered such distinguished services to meteorology, especially in connexion with airships."

Sir Napier Shaw.

"Please express to the Air Ministry on my behalf profound regret and sympathy about the disaster to R 101. They will know better than I how to appreciate the loss of their Chief and the officials on the airship side; but the results and future promise of Giblett's work upon the air came very near to me and the disaster brings them still nearer. I must put on record the consciousness of the gap that his death makes in your scientific staff."

Mr. C. D. Stewart.

"We have just heard here of the dreadful disaster to the R 101. It has naturally come as a great shock, particularly so to me as several of those killed, as well as Mr. Giblett, were well known to me personally; but it can be nothing to the way in which you must have been affected and I can only express my very deep sympathy, while being conscious that nothing that I can put in a letter can convey what I really feel."

Dr. G. Swoboda, Prague.

"Veuillez me permettre de vous assurer que j'ai appris avec un profond regret la nouvelle de l'accident du Dirigeable R 101 qui vient de frapper si cruellement l'Air Ministry, l'Aviation anglaise et toute la nation."

Official Notices

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings will be :—

November 24th, 1930.—*The tephigram, its theory and practical use in weather forecasting.* By C. M. Alvord and R. H. Smith (Cambridge, Mass., Inst. Techn., Prof. Notes No. 1, 1929, and Washington D.C., U.S. Weather Bureau, M.W. Rev. 57, 1929, pp. 361-9). *Opener*—Mr. O. G. Sutton, B.Sc.

December 8th, 1930.—*Visibility and atmospheric dust in Paris. The influence of Paris on the radiation received from the sun and sky in the surrounding region.* By Louis Besson Paris, Ann. Serv. Techn. Hygiène, 10, 1929, pp. 169-95 (in French)). *Opener*—Mr. E. G. Bilham, B.Sc., D.I.C.

Comité Météorologique International

Applicants are invited for the post of Chief of the Secretariat of the International Meteorological Organisation, at present located at De Bilt, Holland, and to be transferred to Switzerland in or before 1935.

The task of the Secretariat is indicated in the Statutes as follows :—

> "Un Secrétariat, fonctionnant sous la Direction du Président du Comité Météorologique International, est chargé de l'organisation des réunions de la Conférence, du Comité et des Commissions ainsi que de la publication des procès-verbaux. Il constitue également un centre de documentation relatif aux services météorologiques du monde entier et il aide, dans toute la mesure de ses moyens, le Président du Comité et les Présidents des Commissions, dans l'exécution de leurs travaux."

It is necessary that applicants should speak at least one international language beside their native language, and be able to correspond in three.

The salary will be £550-750 with £20 increase every year. Superannuation on the British Federative University superannuation scheme: 5 per cent. deducted from salary, 10 per cent. added by employer, 15 per cent. premium to a commercial insurance policy.

Appointment will be made on probation for two years and will be terminable by six months notice on either side.

Further details will be given on application to Prof. E. van Everdingen, President of the International Meteorological Committee, Utrechtscheweg 74, De Bilt, Holland.

Official Publication

PROFESSIONAL NOTES.

No. 59. *Some observations of upper air temperature in Iraq.* By S. P. Peters, B.Sc., A.Inst.P. (M.O. 272S). .

Observations of temperature in the upper air are of considerable importance in meteorology both on account of their theoretical value and also by virtue of their practical application to daily forecasting. Few such observations are available from Iraq and hence special interest attaches to those made there by aeroplane which are recorded and discussed in this note, which reveals conditions, regarding the vertical distribution of temperature over Iraq, markedly different from those usually met with in this country. A knowledge of this is of special importance in aviation.

Books Received

Thirty thousand miles of barograph curves. By Prof. R. de C. Ward (reprinted from the "Geographical Review," xx, No. 2, 1930, pp. 273-7). Being a brief discussion of the record of a barograph during a voyage round the world.

Meteorological observations for 1928, prepared in the Meteorological Office, Wellington. By E. Kidson, D.Sc., F.Inst.P. Wellington, N.Z. 1930.

Hourly values of the weather elements at the Bangalore Observatory, 1914. By C. Seshachar, M.A. Mysore Meteorological Memoirs, No. 10, Bangalore, 1930.

Die physikalischen Grundlagen der meteorologischen Strahlungsforschung und ihre praktische Bedeutung. By Dr. W. Mörikofer (reprinted from the Schweizerischen Medizinischen Wochenschrift 60, 1930, Nr. 15, Seite 333).

The Weather of October, 1930

Mild weather prevailed generally during October, with much rain in the west and southwest and dry, sunny conditions in the east and southeast. The month opened with mainly anticyclonic conditions, which were broken in the southwest by the northward movement of a depression off the coast of Portugal. The 3rd was a particularly sunny day in the southeast, 9·5hrs. sunshine being experienced at Margate, but later small secondary depressions developed over England, giving fairly heavy rain generally during the following night and on the 4th; 2·07in. fell at Borrowdale (Cumberland) and 1·30in. at Oughtershaw

Hall (Yorkshire) on the 4th. A period of unsettled weather ensued, with a large area of low pressure covering the Atlantic and northwest Europe and centres passing eastward across the British Isles. Rain fell daily in most parts, but there were bright periods, especially on the 6th and 9th; 10·2hrs. bright sunshine occurred at Cardiff on the 6th, 10·1hrs. at Durham and 10·0hrs. at Harrogate on the 9th. Rainfall was heaviest and most general on the 7th, when 1·53in. fell at Foffanny (Co. Down). Snow was reported for the first time this autumn on the hills round Inverness and Fort Augustus on the 9th, and ground frosts occurred at many places. Subsequently an anticyclone over the Atlantic moved eastward to central Europe and weather improved over most of England, but continued unsettled, with rain at times in Scotland and Ireland. Sunshine records were generally good in England at this period, especially on the 12th, when 9·9hrs. occurred at Ross-on-Wye. About the 14th the deep depression centred to the south of Iceland, extended eastwards, and the unsettled weather of the west spread over the rest of England. Temperature rose generally, exceeding 65°F. in most parts of England on the 15th-17th, and reaching 70°F. at Greenwich on all three days, while night temperatures in the screen did not fall below 60°F. at places as far apart as Manchester, Ross-on-Wye and Margate on the 15th or 16th. Rain fell generally during this period, but there were many long bright intervals, especially in the southeast; 2·02in. of rain fell at Borrowdale (Cumberland) on the 11th, 2·15in. at Carmarthen on the 15th, and 1·51in. at Foffanny (Co. Down) on the 17th. On the 20th a general change of conditions occurred, and cool, squally northwest winds were experienced in the rear of the depression centred to the southeast of Iceland. For the next week the weather was cold and sunny in the east, but in the west the conditions were cold and unsettled, moderate rain alternating with sunny periods; Dumfries had 8·7hrs. bright sunshine on the 25th, Rothamsted and Clacton 8·9hrs. on the 26th. The coldest days were from the 24th to 27th, temperature not rising above 42°F. at Fort Augustus on the 24th, and 45°F. on the 25th, and 44°F. at Dumfries on the 27th, while the minimum temperature on the grass fell to 18°F. at Burnley and 20°F. at Greenwich on the 27th. Snow and sleet were again reported on the hills in Scotland. A new depression approaching from the Atlantic brought a renewal of mild weather on the 28th, giving cloudy conditions with rain in the north and west, but only a little drizzle in the south. On the 30th and 31st cold air again reached Scotland, but the weather continued mild in England. During the month thunderstorms occurred at Gorleston on the 6th and in the eastern counties on the 24th and 25th, while gales were experienced on the coasts on the 8th, in eastern Scotland on the 18th, and in the west on the

25th. The distribution of bright sunshine was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs).
Stornoway	67	— 19	Liverpool	97	+11
Aberdeen	117	+ 22	Ross-on-Wye	111	+19
Dublin	91	— 13	Falmouth	97	—19
Birr Castle	75	— 23	Gorleston	147	+38
Valentia	66	— 35	Kew	115	+23

Pressure was below normal over the whole of northwest Europe, Svalbard, Iceland, the greater part of the North Atlantic and Bermuda, the greatest deficit being 10·9mb. at Thorshavn (Faroes), while pressure was above normal over southwest Europe, Switzerland, Italy, the Azores and Newfoundland, the greatest excess being 3·8mb. at Madrid. Temperature was above normal over the whole of western Europe but below normal at Spitsbergen. Rainfall was in excess in southern Scandinavia, central Europe and the western British Isles but deficient elsewhere. In eastern Sweden it was as much as 100 per cent above normal.

A storm which raged through France between the 4th and 6th did damage in various districts. On the night of the 9th a dyke on the left bank of the river Nèthe, near Lierre (Antwerp), suddenly gave way owing to the combined pressure of the waters of the river which was in flood, and the action of the wind which was of gale force. The level of the Rhine and its tributaries was reported to have risen on the same day, and floods did much damage to houses and land in the Saar basin. As the result of heavy rains, serious floods occurred in France on the 14th, mostly in the eastern departments. The upper Seine, Marne, Yonne, Meuse and Arve were all in flood. Railways and roads were cut and several mines at Montceau-les-Mines flooded. Dijon and Sédan were partly under water. A violent storm of wind and rain on the 14th swept suddenly through the district near Grenoble, famous for its walnut groves. Before the storm there was an oppressive stillness and a whitish mist spread over the sky. The great wind lasted only a few minutes, but when it dropped the church had lost its steeple, many cottages were unroofed, and nearly 6,000 broken walnut trees lay on the ground. On the 15th the weather over France was fine and warm, and the floods in most districts began to subside, but on the 16th the rivers rose again and the floods continued until after the 21st. The main road between Narbonne and Carcassonne was under water on the 20th. Owing to heavy rain a landslip caused extensive damage at Kalfaret, Bergen, on the 15th, but no lives were lost. At Tarragona (Spain) 14 persons were drowned when the river Francoli flooded the lower parts of the town about the 20th. A heavy northwesterly gale in the Gulf of Lions delayed and damaged shipping on the 25th, 26th and 27th. There was a heavy fall of snow in the Grenoble district and in the Vosges on the 25th, and in the Var, in the Cantal and near Chambéry, on the 27th. A heavy snowstorm swept across the Swiss Alps and the Jura on the 26th covering them with nearly 2ft. of snow down to a level of 2,500ft. Railway services were interrupted in many parts of Czechoslovakia by heavy rain and snow towards the end of the month, and large tracts of land in Moravia and Silesia were flooded on the 31st. Floods in Smyrna following heavy rains on the 26th and 30th caused 134 deaths and rendered 2,500 families homeless.

Rainfall was in excess in Bombay, Deccan, Mysore and Madras during the first half of the month.

Harvest prospects were greatly enhanced by the excellent rains which fell in South and eastern Australia during the first week of the month; further useful rain occurred in New South Wales and Queensland during the second week, while in the third week steady soaking rains ranging to more than 1in. fell in South Australia.

A severe snowstorm interrupted traffic in many parts of central and northern Saskatchewan on the 15th and 16th. At the beginning of the month temperature was generally below normal in the eastern United States, but above normal in the middle regions and along the Pacific coast. The following week, ending the 14th, was abnormally warm with a weekly mean temperature as much as 14°F. above normal at Marquette (Lake Region) and Peoria (Upper Mississippi Valley). This was followed by a sudden drop in temperature, all districts, except parts of the Atlantic coast and the mountain regions, reporting mean temperatures for the week considerably below normal and as much as 22°F. below normal at Havre (Mountain Region). Precipitation was about or slightly below normal generally, except that rather heavy rain fell in the Gulf States during the first week. Over 70 people are believed to have lost their lives in floods at Pachuca, Mexico. In the Argentine temperature was normal early in the month but fell slightly later, while precipitation was about normal for the first three weeks.

The special message from Brazil states that the distribution of rainfall was irregular over the whole country with an average of 0·63in., 0·55in. and 0·67in. above normal in the northern, central and southern regions respectively. Five anticyclones passed across the country. The condition of the crops was improving with the increased rainfall. At Rio de Janeiro pressure was 1·4mb. below normal and temperature 1·8°F. above normal.

Rainfall, October, 1930.—General Distribution

England and Wales	87	per cent of the average 1881-1915.
Scotland	149	
Ireland	162	
British Isles	119	

Rainfall: October, 1930: England and Wales

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square..........	1·27	48	*Leics* .	Belvoir Castle...........	1·56	58
Sur .	Reigate, Alvington.....	1·72	52	*Rut* .	Ridlington...............	1·61	...
Kent .	Tenterden, Ashenden...	2·10	60	*Linc* .	Boston, Skirbeck........	·96	35
,, .	Folkestone, Boro. San..	1·46	...	,, .	Cranwell Aerodrome...	1·59	55
,, .	Margate, Cliftonville...	1·05	36	,, .	Skegness, Marine Gdns	1·37	63
,, .	Sevenoaks, Speldhurst	1·63	...	,, .	Louth, Westgate........	1·59	49
Sus .	Patching Farm.........	3·47	88	,, .	Brigg, Wrawby St.....	2·21	...
,, .	Brighton, Old Steyne..	2·62	68	*Notts* .	Worksop, Hodsock.....	1·82	69
,, .	Heathfield, Barklye....	2·48	60	*Derby* .	Derby, L. M. & S. Rly.	3·06	117
Hants .	Ventnor, Roy. Nat. Hos.	3·39	86	,, .	Buxton, Devon Hos....	7.31	149
,, .	Fordingbridge, Oaklnds	2·23	54	*Ches* .	Runcorn, Weston Pt...	4·92	143
,, .	Ovington Rectory.......	2·09	52	,, .	Nantwich, Dorfold Hall	4·10	...
,, .	Sherborne St. John.....	1·45	41	*Lancs* .	Manchester, Whit. Pk.	4·57	138
Berks .	Wellington College.....	1·16	35	,, .	Stonyhurst College.....	8·01	178
,, .	Newbury, Greenham...	1·58	45	,, .	Southport, Hesketh Pk	5·48	155
Herts .	Welwyn Garden City...	·99	...	,, .	Lancaster, Strathspey	7·22	...
Bucks .	High Wycombe..........	1·19	38	*Yorks* .	Wath-upon-Dearne.....	1·95	70
Oxf . .	Oxford, Mag. College..	1·25	45	,, .	Bradford, Lister Pk....	3·65	105
Nor .	Pitsford, Sedgebrook...	1·47	55	,, .	Oughtershaw Hall......	11·35	...
,, .	Oundle.....................	·82	...	,, .	Wetherby, Ribston H.	2·09	70
Beds .	Woburn, Crawley Mill	1·00	37	,, .	Hull, Pearson Park.....	1·90	64
Cam .	Cambridge, Bot. Gdns.	·81	34	,, .	Holme-on-Spalding.....	2·28	...
Essex .	Chelmsford, County Lab	1·06	43	,, .	West Witton, Ivy Ho.	3·61	...
,, .	Lexden Hill House....	·95	...	,, .	Felixkirk, Mt. St. John	2·41	84
Suff .	Hawkedon Rectory.....	1·12	41	,, .	Pickering, Hungate....	1·91	...
,, .	Haughley House........	·55	...	,, .	Scarborough.............	1·47	47
Norf .	Norwich, Eaton...... ...	·95	30	,, .	Middlesbrough..........	2·08	69
,, .	Wells, Holkham Hall	·94	67	,, .	Baldersdale, Hury Res.	4·05	...
,, .	Little Dunham..........	1·07	34	*Durh* .	Ushaw College..........	2·20	64
Wilts .	Devizes, Highclere......	2·19	70	*Nor* .	Newcastle, Town Moor	1·59	50
,, .	Bishops Cannings.......	2·56	77	,, .	Bellingham. Highgreen	3·61	...
Dor .	Evershot, Melbury Ho.	3·36	73	,, .	Lilburn Tower Gdns....	2·20	...
,, .	Creech Grange..........	2·70	...	*Cumb* .	Geltsdale.................	4·75	...
,, .	Shaftesbury, Abbey Ho.	2·33	60	,, .	Carlisle, Scaleby Hall	4·61	138
Devon .	Plymouth, The Hoe....	4·05	102	,, .	Borrowdale, Seathwaite	23·01	192
,, .	Polapit Tamar..........	7·18	149	,, .	Borrowdale, Rosthwaite	19·32	...
,, .	Ashburton, Druid Ho.	...	...	,, .	Keswick, High Hill.....	10·29	...
,, .	Cullompton.......	4·39	106	*Glam* .	Cardiff, Ely P. Stn.....	5·32	111
,, .	Sidmouth, Sidmount...	3·19	86	,, .	Treherbert. Tynywaun	13·78	...
,, .	Filleigh, Castle Hill....	7·33	...	*Carm* .	Carmarthen Friary.....	7·82	137
,, .	Barnstaple. N. Dev. Ath.	5·82	128	,, .	Llanwrda..................	9·53	150
Corn .	Redruth, Trewirgie.....	5·84	111	*Pemb* .	Haverfordwest, School	7·05	130
,, .	Penzance, Morrab Gdn.	5·71	122	*Card* .	Aberystwyth.............	6·51	...
,, .	St. Austell, Trevarna...	6·63	126	,, .	Cardigan, County Sch.	7·51	...
Soms .	Chewton Mendip.........	4·31	89	*Brec* .	Crickhowell, Talymaes	6·00	...
,, .	Long Ashton............	3·89	...	*Rad* .	Birm W. W. Tyrmynydd	8·72	132
,, .	Street, Millfield	3·33	...	*Mont* .	Lake Vyrnwy...........	9·04	159
Glos. .	Cirencester, Gwynfa....	2·37	72	*Denb* .	Llangynhafal............	4·95	...
Here .	Ross, Birchlea............	2·66	81	*Mer* .	Dolgelly, Bryntirion...	9·51	156
,, .	Ledbury, Underdown..	2·59	84	*Carn* .	Llandudno................	4·63	138
Salop .	Church Stretton.........	3·91	108	,, .	Snowdon, L. Llydaw 9	28·70	...
,, .	Shifnal, Hatton Grange	3·29	116	*Ang* .	Holyhead, Salt Island	6.11	153
Worc .	Ombersley, Holt Lock	3·08	115	,, .	Lligwy.....................	6·13	...
,, .	Blockley..................	2·27	...	*Isle of Man*			
War .	Farnborough.............	...	...		Douglas, Boro' Cem....	8·02	176
,, .	Birminghm, Edgbaston	2·84	102	*Guernsey*			
Leics .	Thornton Reservoir....	2·20	78		St. Peter P't. Grange Rd.	3·58	80

Rainfall: October, 1930: Scotland and Ireland

Co.	STATION	In.	Per-cent of Av.	Co.	STATION	In.	Per-cent. of Av.
Wigt.	Pt. William, Monreith	7·22	...	*Suth* .	Loch More, Achfary ...	11·20	144
,, .	New Luce School......	7·49	...	*Caith* .	Wick......................	3·64	123
Kirk .	Carsphairn, Shiel.......	14·15	...	*Ork* .	Pomona, Deerness......	4·88	129
Dumf.	Dumfries, Crichton, R.I	6·13	165	*Shet* .	Lerwick	4·74	120
,, .	Eskdalemuir Obs.......	11·51	213	*Cork* .	Caheragh Rectory......	6·50	...
Roxb .	Branxholm	6·27	193	,, .	Dunmanway Rectory...	6·84	114
Selk .	Ettrick Manse...........	10·86	...	,, .	Ballinacurra..............	4·97	122
Peeb .	West Linton............	5·12	...	,, .	Glanmire, Lota Lo......	5·24	126
Berk .	Marchmont House......	3·85	101	*Kerry*.	Valentia Obsy..........	7·48	134
Hadd.	North Berwick Res.....	1·88	64	,, .	Gearahameen.............	8·80	...
Midl .	Edinburgh, Roy. Obs.	3·17	122	,, .	Killarney Asylum......	7·98	149
Ayr .	Kilmarnock, Agric. C.	6·09	173	,, .	Darrynane Abbey.......	7·09	141
,, .	Girvan, Pinmore..	9·06	181	*Wat* .	Waterford, Brook Lo...	6·15	157
Renf .	Glasgow, Queen's Pk. .	6·44	198	*Tip* .	Nenagh, Cas. Lough...	6·93	204
,, .	Greenock, Prospect H.	10·17	189	,, .	Roscrea, Timoney Park	5·51	...
Bute .	Rothesay, Ardencraig.	9·56	217	,, .	Cashel, Ballinamona...	6·17	171
,, .	Dougarie Lodge.........	7·54	...	*Lim* .	Foynes, Coolnanes......	6·86	181
Arg .	Ardgour House	17·48	...	,, .	Castleconnel Rec.......	6·48	...
,, .	Manse of Glenorchy...	12·36	...	*Clare* .	Inagh, Mount Callan...	10·73	...
,, .	Oban......................	8·12	...	,, .	Broadford, Hurdlest'n.	6·36	...
,, .	Poltalloch	9·29	188	*Wexf*.	Gorey, Courtown Ho...	5·36	151
,, .	Inveraray Castle...	12·94	184	*Kilk* .	Kilkenny Castle.........	4·66	148
,, .	Islay, Eallabus.........	10·94	229	*Wic* .	Rathnew, Clonmannon	5·26	...
,, .	Mull, Benmore.........	13.10	...	*Carl* .	Hacketstown Rectory..	6·17	162
,, .	Tiree	6·40	...	*Leix* .	Blandsfort House......	4·91	140
Kinr .	Loch Leven Sluice......	3·59	104	,, .	Mountmellick...........	5·35	...
Perth .	Loch Dhu................	11·50	161	*Off'ly* .	Birr Castle..............	4·64	159
,, .	Balquhidder, Stronvar	11·63	...	*Kild'r*.	Monasterevin	4·06	...
,, .	Crieff, Strathearn Hyd.	4·63	118	*Dubl* .	Dublin, FitzWm. Sq...	3·85	144
,, .	Blair Castle Gardens...	5·80	187	,, .	Balbriggan, Ardgillan.	3·29	122
,, .	Glen Bruar, Bruar Ldg.	8·21	...	*Me'th* .	Beauparc, St. Cloud...	4·78	...
Angus.	Kettins School.	3·00	105	,, .	Kells, Headfort.........	5·95	177
,, .	Dundee, E. Necropolis	2·77	104	*W.M* .	Moate, Coolatore......	4·50	...
,, .	Pearsie House...........	3·69	...	,, .	Mullingar, Belvedere..	6·11	196
,, .	Montrose, Sunnyside...	2·69	97	*Long* .	Castle Forbes Gdns......	5·64	173
Aber .	Braemar, Bank...	5·65	150	*Gal* .	Ballynahinch Castle...	10·04	168
,, .	Logie Coldstone Sch....	3·13	97	,, .	Galway, Grammar Sch.	6·35	...
,, .	Aberdeen, King's Coll.	3·05	102	*Mayo* .	Mallaranny..............	4·08	...
,, .	Fyvie Castle.............	4·31	...	,, .	Westport House.........	8·34	185
Moray.	Gordon Castle..........	4·39	139	,, .	Delphi Lodge...........	15·95	...
,, .	Grantown-on-Spey......	...	...	*Sligo* .	Markree Obsy..........	7·27	177
Nairn.	Nairn, Delnies	3·72	158	*Cav'n* .	Belturbet, Cloverhill...	4·69	161
Inv .	Kingussie, The Birches	4·51	...	*Ferm* .	Enniskillen, Portora...	6·42	
,, .	Loch Quoich, Loan.....	18·31	...	*Arm* .	Armagh Obsy...........	5·35	197
,, .	Glenquoich..............	17·85	178	*Down* .	Fofanny Reservoir......	9·78	...
,, .	Inverness, Culduthel R.	3·17	...	,, .	Seaforde.................	5·76	162
,, .	Arisaig, Faire-na-Squir	7·89	...	,, .	Donaghadee, C. Stn...	4·78	165
,, .	Fort William............	12·60	...	,, .	Banbridge, Milltown...	3·99	...
,, .	Skye, Dunvegan........	10·89	...	*Antr* .	Belfast, Cavehill Rd...	5·94	...
R & C.	Alness, Ardross Cas ...	6·12	159	,, .	Glenarm Castle.........	7·24	...
,, .	Ullapool	7·11	...	,, .	Ballymena, Harryville	6·90	187
,, .	Torridon, Bendamph...	10·84	135	*Lon* .	Londonderry, Creggan	7·41	201
,, .	Achnashellach..........	10·65	...	*Tyr* .	Donaghmore	6·01	...
,, .	Stornoway...............	...	...	,, .	Omagh, Edenfel.........	6·77	184
Suth .	Lairg.....................	5·98	...	*Don* .	Malin Head..............	5·43	...
,, .	Tongue	5·29	126	,, .	Dunfanaghy.............	5·99	...
,, .	Melvich..................	5·79	...	,, .	Killybegs, Rockmount.	9·24	165

Climatological Table for the British Empire, May, 1930.

STATIONS	PRESSURE		TEMPERATURE									PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb	Relative Humidity.	Mean Cloud Am'nt	Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy. ..	1014·8	— 1·1	71	39	60·4	46·6	53·5	+ 0·1	47·4	83	7·3	3·46	+ 1·74	19	4·9	32
Gibraltar	1017·6	+ 1·5	90	52	74·0	57·1	65·5	0·0	56·6	84	3·3	0·34	— 1·39	3	..	..
Malta	1015·7	+ 0·7	81	54	69·4	58·9	64·1	— 1·8	59·1	75	5·3	0·34	— 0·07	2	9·5	68
St. Helena	1015·2	+ 1·3	..	57	..	59·0	..	..	59·8	91	7·5	2·22	— 1·93	12	..	..
Sierra Leone	1014·2	+ 3·0	90	70	85·1	73·7	79·4	— 2·1	76·1	85	7·7	9·89	— 1·58	15	..	..
Lagos, Nigeria	1010·0	— 1·0	90	72	87·8	75·9	81·9	+ 0·1	77·5	82	8·2	8·61	— 1·86	16	..	..
Kaduna, Nigeria	1014·7	+ 2·0	93	65	89·1	70·5	79·8	+ 0·4	72·6	76	1·0	6·34	+ 0·40	20	..	..
Zomba, Nyasaland ..	1017·2	+ 2·1	79	51	72·2	55·8	64·0	— 1·8	..	79	5·7	0·14	— 0·90	4	..	..
Salisbury, Rhodesia ..	1018·3	+ 1·6	77	41	70·0	47·6	58·8	— 1·8	51·6	54	2·9	0·00	— 0·54	0	7·6	68
Cape Town	1021·2	+ 3·2	89	41	74·2	52·4	63·3	+ 4·4	52·7	75	3·7	0·30	— 3·45	6	..	..
Johannesburg	1023·7	+ 2·7	72	31	66·3	43·9	55·1	+ 0·7	43·0	45	1·1	0·78	+ 0·02	3	9·5	87
Mauritius	1017·6	+ 1·2	83	61	79·3	67·5	73·4	+ 0·8	69·3	69	4·1	2·54	— 0·49	15	8·2	73
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calcutta, Alipore Obsy.	1003·8	+ 0·3	102	72	95·9	79·1	87·5	+ 1·5	79·7	82	6·0	4·66	— 1·09	8*	..	..
Bombay	1007·8	+ 0·4	93	79	92·2	81·2	86·7	+ 0·8	78·2	73	2·2	0·02	— 0·53	0*	..	..
Madras	1005·2	— 0·2	107	73	96·7	78·9	87·8	— 2·1	77·8	70	5·7	8·14	+ 7·07	5*	..	..
Colombo, Ceylon	1009·5	+ 0·9	88	73	86·2	77·1	81·7	— 0·8	78·4	82	7·3	26·24	+ 13·56	24	6·9	56
Hongkong	1009·0	+ 0·4	89	73	83·5	76·2	79·9	+ 2·5	75·6	79	7·3	6·19	— 5·41	14	6·6	50
Sandakan	..	..	92	73	88·9	75·2	82·1	— 0·5	77·6	82	..	8·56	+ 2·65	17	..	..
Sydney, N.S.W.	1023·6	+ 5·0	74	46	66·2	51·6	58·9	+ 0·1	53·7	82	5·0	5·05	— 0·08	9	6·1	59
Melbourne	1024·6	+ 5·1	76	35	63·4	47·2	55·3	+ 1·2	50·6	70	5·9	3·26	+ 1·08	11	4·6	49
Adelaide	1024·0	+ 3·9	80	43	69·6	51·2	60·4	+ 2·5	51·5	57	5·0	1·14	— 1·62	6	5·9	58
Perth, W. Australia ..	1018·9	+ 0·4	79	47	70·8	54·6	62·7	+ 2·1	56·9	75	6·0	2·47	— 2·47	12	5·4	52
Coolgardie	1020·3	+ 0·5	83	37	73·0	49·2	61·1	+ 3·5	52·9	60	4·2	1·36	0·00	5	..	..
Brisbane	1022·2	+ 3·4	81	50	72·0	56·6	64·3	— 0·2	59·1	74	4·9	7·98	+ 5·15	15	5·9	55
Hobart, Tasmania	1021·6	+ 6·0	71	37	59·4	45·5	52·5	+ 2·1	46·8	71	6·1	1·47	— 0·39	12	4·6	47
Wellington, N.Z.	1019·4	+ 3·8	62	35	56·4	44·9	50·7	— 2·0	47·9	79	5·4	2·59	— 2·09	8	5·6	57
Suva, Fiji	1013·0	+ 0·2	88	68	81·2	72·1	76·7	+ 0·2	72·4	80	8·0	11·18	+ 1·02	25	2·7	24
Apia, Samoa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kingston, Jamaica	1013·6	+ 0·5	91	68	88·5	72·4	80·5	+ 0·8	72·2	77	3·0	0·96	— 3·43	4	8·3	64
Grenada, W.I.	1014·0	+ 1·5	90	72	87·8	74·0	80·9	+ 1·3	74·2	77	3·3	1·74	— 2·85	13	..	..
Toronto	1015·3	+ 0·5	87	37	67·3	47·7	57·5	+ 4·8	50·4	67	4·9	2·74	— 0·24	14	8·0	54
Winnipeg	1013·3	— 1·0	91	26	60·1	40·7	50·4	— 1·2	43·8	90	6·5	4·11	+ 1·81	16	5·9	38
St. John, N.B.	1013·2	— 0·8	72	35	57·7	40·4	49·1	+ 1·4	44·3	68	5·4	2·05	— 1·66	14	6·9	46
Victoria, B.C.	1015·5	— 0·9	68	39	58·5	45·5	52·0	— 1·1	47·8	77	5·6	0·53	— 0·77	6	9·2	61

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Climatological Table for the British Empire, May, 1930.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb							
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1014·8	— 1·1	71	39	60·4	46·6	53·5	+ 0·1	47·4	83	7·3	3·46	+ 1·74	19	4·9	32
Gibraltar	1017·6	+ 1·5	90	52	74·0	57·1	65·5	0·0	56·6	84	3·3	0·34	— 1·39	3	..	..
Malta	1015·7	+ 0·7	81	54	69·4	58·9	64·1	— 1·8	59·1	75	5·3	0·34	— 0·07	2	9·5	68
St. Helena	1015·2	+ 1·3	..	57	..	59·0	..	..	59·8	91	7·5	2·22	— 1·93	12	..	..
Sierra Leone	1014·2	+ 3·0	90	70	85·1	73·7	79·4	— 2·1	76·1	85	7·7	9·89	— 1·58	15	..	..
Lagos, Nigeria	1010·0	— 1·0	90	72	87·8	75·9	81·9	+ 0·1	77·5	82	8·2	8·61	— 1·86	16	..	..
Kaduna, Nigeria	1014·7	+ 2·0	93	65	89·1	70·5	79·8	+ 0·4	72·6	76	1·0	6·34	+ 0·40	20	..	..
Zomba, Nyasaland	1017·2	+ 2·1	79	51	72·2	55·8	64·0	— 1·8	..	79	5·7	0·14	— 0·90	4	..	..
Salisbury, Rhodesia	1018·3	+ 1·6	77	41	70·0	47·6	58·8	— 1·8	51·6	54	2·9	0·00	— 0·54	0	7·6	68
Cape Town	1021·2	+ 3·2	89	41	74·2	52·4	63·3	+ 4·4	52·7	75	3·7	0·30	— 3·45	6	..	..
Johannesburg	1023·7	+ 2·7	72	31	66·3	43·9	55·1	+ 0·7	43·0	45	1·1	0·78	+ 0·02	3	9·5	87
Mauritius	1017·6	+ 1·2	83	61	79·3	67·5	73·4	+ 0·8	69·3	69	4·1	2·54	— 0·49	15	8·2	73
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calcutta, Alipore Obsy.	1003·8	+ 0·3	102	72	95·9	79·1	87·5	+ 1·5	79·7	82	6·0	4·66	— 1·09	8*	..	..
Bombay	1007·8	+ 0·4	93	79	92·2	81·2	86·7	+ 0·8	78·2	73	2·2	0·02	— 0·53	0*	..	..
Madras	1005·2	— 0·2	107	73	96·7	78·9	87·8	— 2·1	77·8	70	5·7	8·14	+ 7·07	5*	..	..
Colombo, Ceylon	1009·5	+ 0·9	88	73	86·2	77·1	81·7	— 0·8	78·4	82	7·3	26·24	+ 13·56	24	6·9	56
Hongkong	1009·0	+ 0·4	89	73	83·5	76·2	79·9	+ 2·5	75·6	79	7·3	6·19	— 5·41	14	6·6	50
Sandakan	..	..	92	73	88·9	75·2	82·1	— 0·5	77·6	82	..	8·56	+ 2·65	17	..	..
Sydney, N.S.W.	1023·6	+ 5·0	74	46	66·2	51·6	58·9	+ 0·1	53·7	82	5·0	5·05	— 0·08	9	6·1	59
Melbourne	1024·6	+ 5·1	76	35	63·4	47·2	55·3	+ 1·2	50·6	70	5·9	3·26	+ 1·08	11	4·6	49
Adelaide	1024·0	+ 3·9	80	43	69·6	51·2	60·4	+ 2·5	51·5	57	5·0	1·14	— 1·62	6	5·9	58
Perth, W. Australia	1018·9	+ 0·4	79	47	70·8	54·6	62·7	+ 2·1	56·9	75	6·0	2·47	— 2·47	12	5·4	52
Coolgardie	1020·3	+ 0·5	83	37	73·0	49·2	61·1	+ 3·5	52·9	60	4·2	1·36	0·00	5	..	..
Brisbane	1022·2	+ 3·4	81	50	72·0	56·6	64·3	— 0·2	59·1	74	4·9	7·98	+ 5·15	15	5·9	55
Hobart, Tasmania	1021·6	+ 6·0	71	37	59·4	45·5	52·5	+ 2·1	46·8	71	6·1	1·47	— 0·39	12	4·6	47
Wellington, N.Z.	1019·4	+ 3·8	62	35	56·4	44·9	50·7	— 2·0	47·9	79	5·4	2·59	— 2·09	8	5·6	57
Suva, Fiji	1013·0	+ 0·2	88	68	81·2	72·1	76·7	+ 0·2	72·4	80	8·0	11·18	+ 1·02	25	2·7	24
Apia, Samoa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kingston, Jamaica	1013·6	+ 0·5	91	68	88·5	72·4	80·5	+ 0·8	72·2	77	3·0	0·96	— 3·43	4	8·3	64
Grenada, W.I.	1014·0	+ 1·5	90	72	87·8	74·0	80·9	+ 1·3	74·2	77	3·3	1·74	— 2·85	13	..	..
Toronto	1015·3	+ 0·5	87	37	67·3	47·7	57·5	+ 4·8	50·4	67	4·9	2·74	— 0·24	14	8·0	54
Winnipeg	1013·3	— 1·0	91	26	60·1	40·7	50·4	— 1·2	43·8	90	6·5	4·11	+ 1·81	16	5·9	38
St. John, N.B.	1013·2	— 0·8	72	35	57·7	40·4	49·1	+ 1·4	44·3	68	5·4	2·05	— 1·66	14	6·9	46
Victoria, B.C.	1015·5	— 0·9	68	39	58·5	45·5	52·0	— 1·1	47·8	77	5·6	0·53	— 0·77	6	9·2	61

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

M.O. 326.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 65
Dec., 1930
No. 779

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH; YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 15, DONEGALL SQUARE WEST, BELFAST; or through any Bookseller.

Thunderstorms of November 2nd, 1930

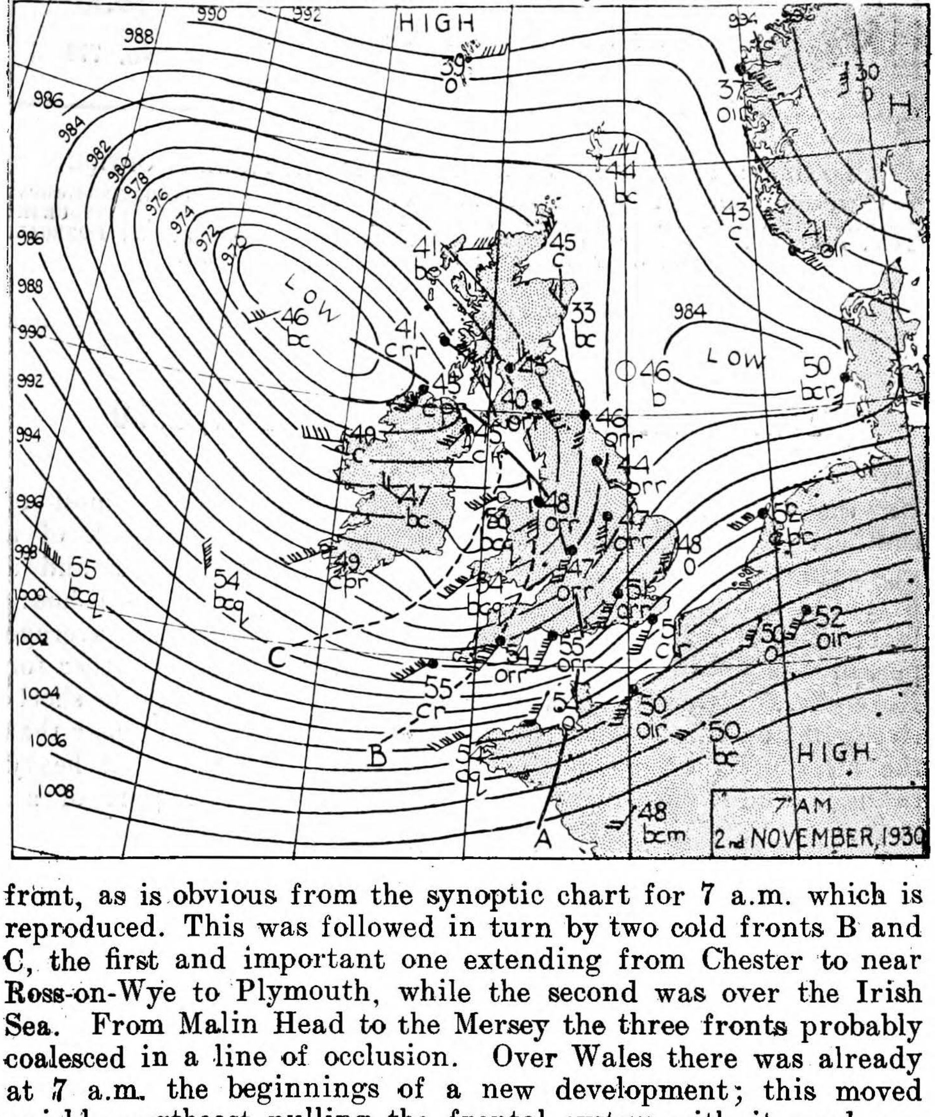
By F. H. DIGHT, B.Sc.

On the morning of Sunday, November 2nd, 1930, most of southern England was startled by the sudden outbreak of a vigorous thunderstorm, accompanied by squally winds and a period of heavy rain. Rain had fallen steadily for several hours before and the character of the storm was such that the average person was justified in referring to it as "unusual weather for November." Generally, winter thunderstorms are quite short-lived, but on this occasion in London, and it would appear that the Metropolis experienced the full force of the storm, heavy thunder and lightning continued for the greater part of an hour.

The stormy opening of the month was the result of a complex series of disturbances passing northeastwards right across the country. At 6 p.m., November 1st, there were indications of a development westward of Ireland, and a few hours later a new fall of the barometer set in over the country. The intensity of the development can be gauged from the fact that at Blacksod Point the pressure fell 12mb. between 10 p.m. and 1 a.m., when a new low-pressure centre was located in that area. There was a corresponding fall of 8mb. at Valentia, and gales were blowing on the west coast of Ireland. By 7 a.m. more precise information of the structure of the new system was available. The new centre was then near Malin Head; the gale had extended

(92066) P.S.14/89 1,050 12/30 M. & S. Gp.303

to the western English Channel, and the southerly winds were steadily increasing over England. It was apparent that the system had an appreciable warm sector and conditions were favourable for further development. The warm front had progressed roughly half-way across southern England, and it was raining steadily in advance of the warm front over practically the whole of England and southern Scotland. As is usual in depressions of this type the actual arrival of the warm front A (see map) is very indistinctly shown on the autographic records, although the air behind it was distinctly warmer than that in front, as is obvious from the synoptic chart for 7 a.m. which is reproduced. This was followed in turn by two cold fronts B and C, the first and important one extending from Chester to near Ross-on-Wye to Plymouth, while the second was over the Irish Sea. From Malin Head to the Mersey the three fronts probably coalesced in a line of occlusion. Over Wales there was already at 7 a.m. the beginnings of a new development; this moved quickly northeast pulling the frontal system with it, and was located as an entirely new centre over Tynemouth at 1 p.m. The original centre then began to rotate in an anti-clockwise direction around the newly formed centre, until finally the two



coalesced to form a vigorous simple system over Denmark by 7 a.m. on November 3rd. As a result of these complex developments there was a prolonged and rapid fall of the barometer over the whole country which lasted for about 20 hours over the south and amounted to 28mb., of which a fall of 18mb. was accounted for by the formation and subsequent motion of the new centre over Wales.

It was with the passage of the first cold front on the morning of the 2nd that the violent phenomena to be described were associated. The second cold front passed over most of southern England during the early afternoon and was accompanied by a certain squalliness of the wind, local hail and thunder over a wide area, but on the whole with only slight precipitation. For a time there was a lull in the gale and strong winds. The passage of the final trough line associated with the swinging of the original centre followed much later, and was accompanied by further rain. There was a very definite veer of the wind which increased again to gale force over the whole of the western half of the country, and it was not until after the final trough had passed that the full force of a prolonged gale was experienced in this area. During the final blow which lasted several hours gust velocities exceeding 70 m.p.h. were registered in the west.

Reports from F. J. Parsons, Esq., Ross-on-Wye, from R. Gray, Esq., F.R.Met.Soc., Dorstone, and from F. Winter, Esq., Clevedon, show that the thunderstorms broke out in the Hereford-Somerset area about 7.30 a.m. with the passage of the first cold front, and were followed by a second outbreak with hail well within the hour, each storm being accompanied by periods of heavy rain. The storm line travelled eastwards, reaching London a little before 10.30 a.m., finally passing away to the North Sea about an hour later. The thunderstorm area seems to have been restricted; no reports of thunder were received from places along the south coast, while on the northern side Leafield (Oxon.) and Cardington (Beds.) both escaped, although in the narrow belt between these rough limits the storms appear to have been general, but as we shall see the squall phenomena, like the incidence of the heavy rain, were less restricted. The outstanding feature was the increasing vigour of the storm as it moved eastwards. At first, in the west, there were two separate thunderstorms, but by the time they reached London these had developed into one prolonged thunderstorm of approximately one hour's duration which was accompanied by heavy rain, and locally by hail. In London an observer noted 43 distinct claps of thunder in the hour. It is interesting to notice that the thunder was of the " booming and rattling " variety as the observer at Ross so aptly described it in his report, indicating that cloud to cloud lightning discharges predominated. Consequently reports of lightning damage were remarkably few (see *The Times* of November 3rd), whereas during a similar type of storm on the night of December 6th, 1929, when cloud to earth discharges predominated, several people received fatal injuries and much structural damage was done.

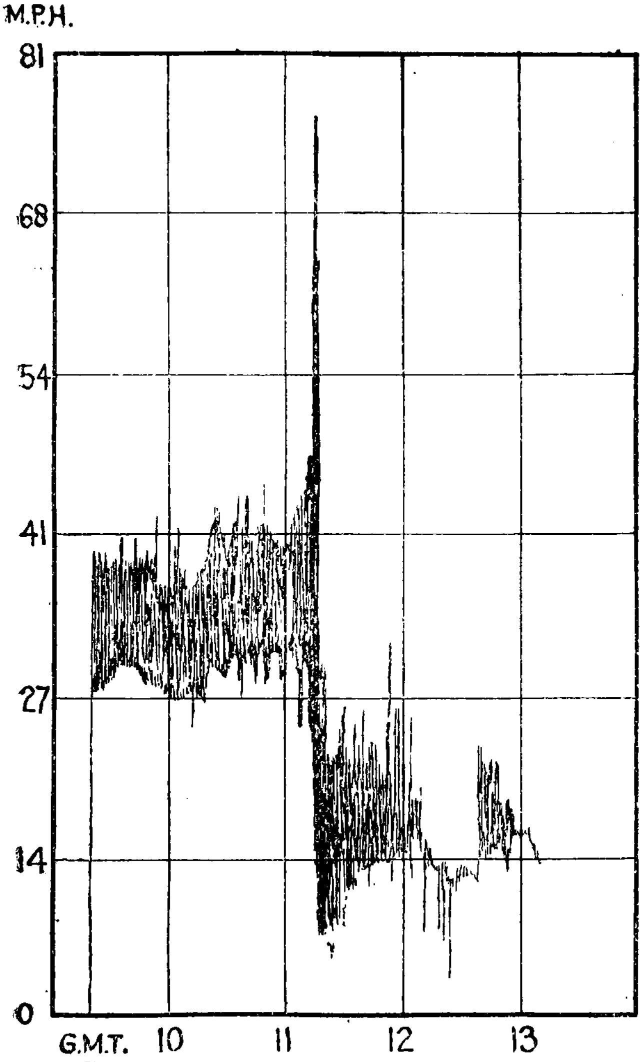
The barograms from stations in the path of the storm are equally eloquent of the intensification of the phenomena, the record from Ross-on-Wye showing just a " kink " or temporary check in the continued fall during the passage of the front, whereas the records made in southeast England show a very sharp fall, followed by an almost instantaneous recovery, the amplitude being about 1mb. At Shoeburyness, where the storm reached its maximum intensity, the barogram shows a practically instantaneous drop and immediate recovery of 4·5mb. With the onset of the storm there was a rapid drop in temperature of from 4°F. to 7°F. over the whole of the south, but with the bright sunshine that accompanied the clearance, the temperature soon regained its former level.

For a stormy November day the total rainfalls over the country during Saturday night and throughout Sunday were not excessive, the heaviest falls averaging between 0·7in. to 1in. over southern England. The more important feature concerns the measurements recorded during the thunderstorm, and here again the intensification over southeast England is very marked. The heavy rain accompanying the passage of the front was noted over a much wider area than the actual thunderstorms, but it was only over a relatively narrow belt perhaps 50 miles wide eastward from west London that markedly heavy falls occurred in relatively short periods at the height of the storm. The largest falls so far to hand under this heading are :—

(1) 13·5mm. (0·53in.) in 11 minutes. S. C. Russell, Esq., Worcester Park, Surrey.
(2) 8·4mm. (0·33in) in 15 minutes. L. C. Johnson, Esq., Streatham Common.
(3) 11·7mm. (0·46in.) in 30 minutes. E. E. Roper, Esq., F.R.Met.Soc., Hildenborough, Kent.
(4) 7mm. (0·28in.) in 18 minutes. Meteorological Office, Croydon Aerodrome.

Unfortunately a record of what was probably the heaviest fall was lost when the gauges at Shoeburyness were overturned during the storm. These figures do not represent the total fall associated with the passage of the first cold front, but only that of the period of heaviest rain, whereas on the other hand only 4 mm. (0·16in.) were measured at Cardington, Worthy Down and Felixstowe, and 8 mm. (0·31in.) at Lympne during the whole period of this phase.

In addition to the thunder and heavy rain, a further feature of the storm was the markedly squally character of the wind. In its earlier stages the change from the warm sector air to the colder air behind it was marked by squally weather to which the reports from the west country testify, but again it was not until the front approached London that the squalls became exceptionally heavy. On the anemograms from Worthy Down (Winchester) and South Farnborough the initial stages of a definite squall can be picked out superimposed on the general squalliness which preceded the arrival of the front. By the time the front reached Croydon the final squall was much more developed and is distinctly shown on the anemogram at 10.15 a.m. as an additional feature of the storm. The maximum gusts recorded at some of the stations affected were: Calshot and Kew, 65 m.p.h.; Croydon, 55 m.p.h.; and Felixstowe, 53 m.p.h. But it was at Cardington and more particularly at Shoeburyness that the squall assumed unusual proportions. Prior to the arrival of the squall line at Cardington the average wind speed at 150 ft. above the ground was 37 m.p.h. with a maximum gust velocity of 57 m.p.h., but just before 10 a.m. there were a series of very violent gusts over a period of 10 minutes, during which a maximum velocity of 82 m.p.h. was registered. At Shoeburyness the squall was of an even more violent nature (a copy of the anemogram for this period is reproduced), and although the structure of the squall was similar to that at Cardington, the time interval during which the outstanding gusts were operative was reduced to something between one and five



Copy of portion of anemogram.
Shoeburyness, November 2nd, 1930.

minutes. Following a mean wind speed of 37 m.p.h. prior to the arrival of the squall, a close examination of the trace shows that there were four main gusts of 48, 76, 64 and 41 m.p.h., respectively. Accompanying the squall were many of the phenomena of a " miniature cyclone " or tornado—sudden darkness, very low clouds, thunder and lightning, a loud roaring sound, and torrential rain. Extensive damage was done to buildings, trees, huts and fences along a narrow straight track only 1,000 feet wide extending westsouthwest to eastnortheast across the town. A very careful and systematic examination of the damage, however, proves conclusively that the storm was a " straight blow " and not a tornado or a whirlwind. This conclusion is based on the fact that all the fallen trees, and all the tree tops which were snapped off, fell towards a northeast point. In addition none of the trees which were snapped off show signs of wrenching, nor the stumps signs of the heads having been twisted off. All the reports agree that the winds experienced were from between SW. and WSW.

Subsequently the storm seems to have lost much of its vigour, the last remnant of it being a gust of 71 m.p.h. at Lympne at 12.20 p.m.

The average east-west component of the surface velocity of the first cold front was about 40 m.p.h. which, when due allowance has been made for the fact that the gradient was southwesterly, is appreciably less than the geostrophic gradient of 70 m.p.h. would suggest, and it was probably due to this fact that the frontal phenomena became so much intensified as the front crossed southeast England.

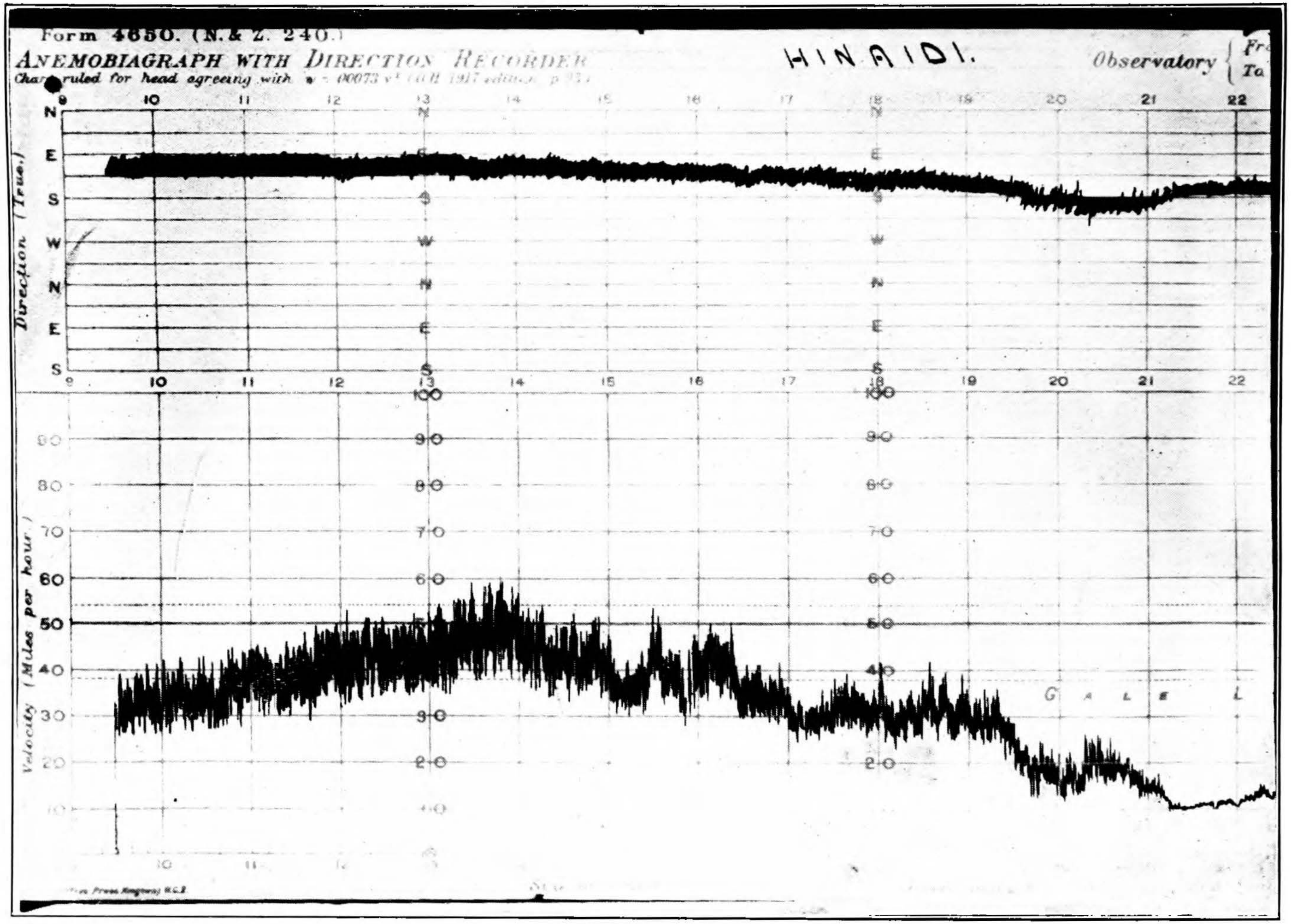
The writer is indebted to Mr. C. E. Britton, the Meteorological Officer at Shoeburyness, for details of the storm there, from whose report he has quoted extensively.

A Drawback of Leeside Exposures

The importance of Major Goldie's concluding remarks in the note entitled " A ' Record ' Gust," in the August number of the *Meteorological Magazine* (Vol. 65, p. 165), deserves close attention especially from those meteorologists who advise on aviation matters.

Major Goldie writes: " But at the same time the Glen Nevis gust and other general features of the Glen Nevis records demonstrate that however much the shelter of mountains may reduce the mean wind speed in the valleys the risk at least remains of the occurrence once in a while of a (sudden) gust of practically the same order of force as those experienced in the most exposed places."

These remarks can be illustrated, after allowance for the



ANEMOBIAGRAPH RECORDS, HINAIDI, JANUARY 6TH, 1930 (see p. 267).

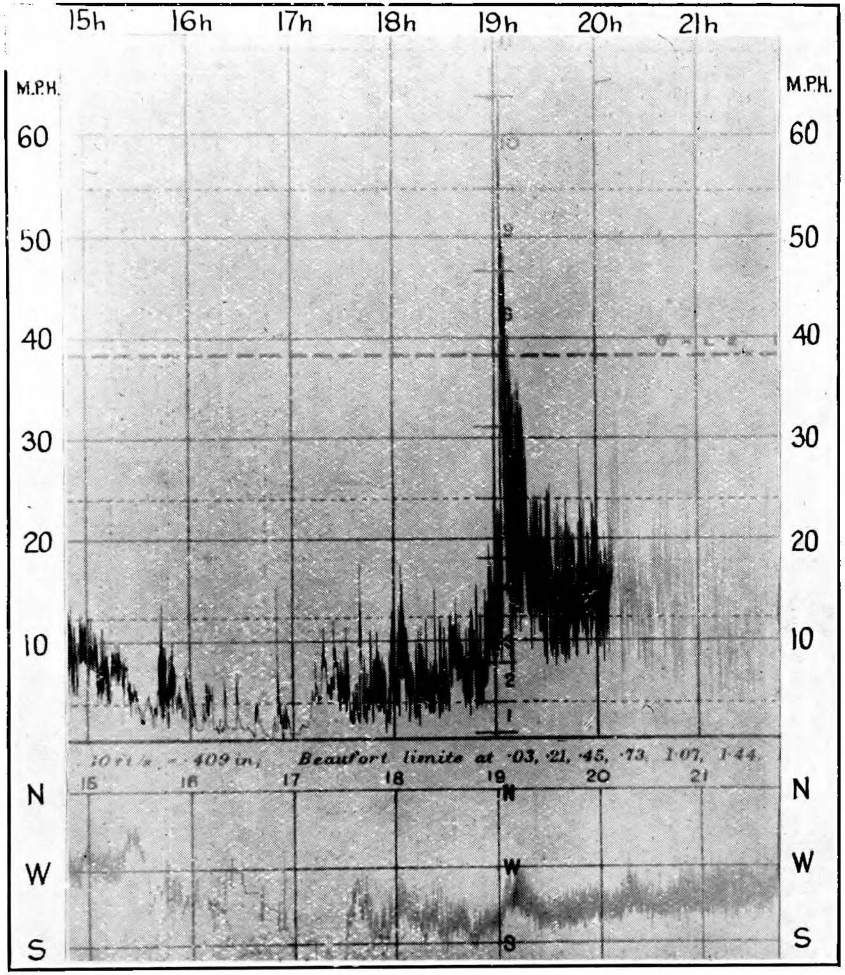


Fig. 1. Anemogram, Sealand, December 2nd, 1930.

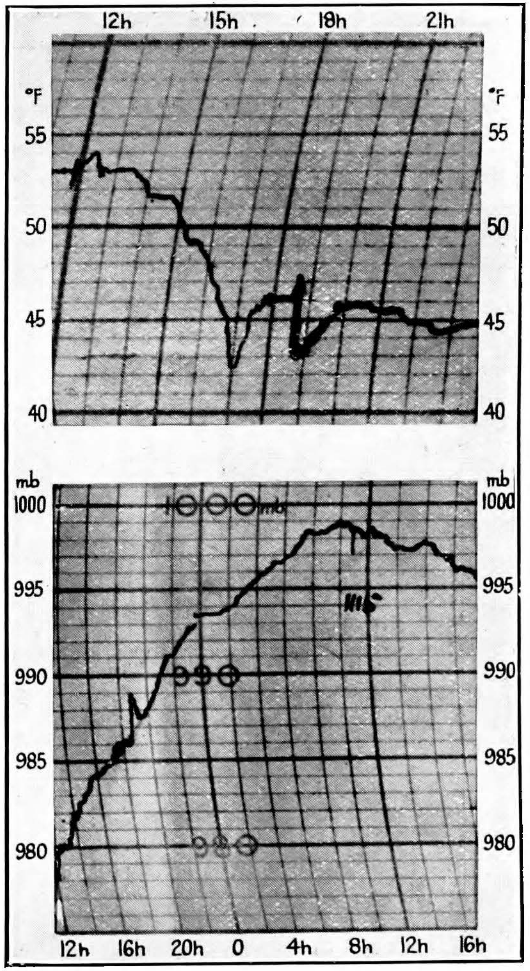


Fig. 2. Thermogram and Barogram, Sealand, December 2nd, 1930.

differences of exposure, from the anemometer records of Sealand (Cheshire), the site of which, between southsouthwest and west, is close to the Welsh mountains. The only amendment which one would like to suggest to this statement is the addition of the word " sudden " printed in the brackets above. It is to show the unexpected nature of these gusts, unexperienced at more open exposures, that a portion of the anemometer trace for December 2nd, 1929, is reproduced (Fig. 1). The gust occurred at 19h. 5m. G.M.T. From a scrutiny of pressure and temperature it exhibits all the characteristics of a line-squall. At the time the pressure distribution was favourable for such occurrences. There was a very deep depression southwest of Iceland (940mb.) with the run of the isobars, enclosing air of polar origin, over Ireland and England from the southwest. Four ships on the Atlantic reported air temperatures not below 46°, whilst reports of hail and thunderstorms indicated the general instability during the afternoon. There was an opening of the gradient over Wales and northwest England at 18h. that was not present on the 13h. map.

Although this sudden gust was undoubtedly in essence a line-squall, it is difficult to reconcile its abruptness except on grounds of configuration. The fact that sudden increases of such magnitude at open exposures in flat country are unknown, is one clue. The other clues are involved in sequences of temperature changes, that are difficult to explain concisely or perhaps very accurately.

The following explanation involves the assumption that the air at the high levels on the Welsh mountains cools more rapidly in similar conditions than the air in the plain below where this station stands. The cooling indicated by the drop of temperature (see Fig. 2) before 17h. is due to radiation though retarded somewhat by the weak sunshine up to 16h. consequent on a clear sky after 14h. (see Table 1). After 17h. the rise corresponds with the veer of the wind to SW which points to warming by descending air from the lower mountain levels in that quarter. In turn this descending air was followed by colder air presumably from the higher mountain levels, which despite its descent was eventually colder. It is significant that the minimum temperature at 17h., attributed to radiation, is 0·5° lower than the minimum temperature of the gust at 19h. 5m., suggesting that the replacing air has been somewhat warmed up—probably mainly through descent.

Moreover the continuity of the barograph trace (Fig. 3) negatives, as well as the stately isolation of the gust itself on the anemogram, any general, as distinct from particular, arrival of cold air attributable to the cyclonic circulation. Pressure was rising steadily and the incidence of the gust stands out on the barogram as an interruption of the steady rise then in progress. Such cascades can be only temporary if they are due to configuration, and the records reflect this fact unmistakeably, *e.g.*, on the thermogram, after the gust the temperature comes back again to 46°, which was about the general temperature of the surface air as reported by the four ships for the 18h. weather map. Moreover the lightning is indicative of local instability—see for a precisely similar effect, though in relation to equatorial air exclusively, the early morning thunderstorms in the north Wales area of August 27th, 1930.

TABLE I.—SQUALL AT 19H. 5M. G.M.T., DECEMBER 2ND, 1929.

Time	Weather	Wind	Temp.	Humidy.	Rain	Pressure	Remarks
			°F	%	mm.	mb.	
14h	cv.	W 16mph gusty	52·6	70	0·0	981·8	Sky cleared rapidly at 14h15m
15h	b.	W'N 10 mph	50·8	67	0·0	983·0	
16h	b.	SW'W 4 mph	48·0	66	0·0	984·3	
17h	b.	Calm	43·0	77	0·0	985·0	
18h	b.	SW 8 mph	45·7	72	0·0	986·4	lightning to WNW at 18h15m pressure tending to fall for about ¾h
19h	—	SSW 13 mph	46·0	70	0·0	986·0	
19h 5m	KQRb.	SW'W 68 mph	47—43	89	2·0	986-989	falling to 987·5mb. by 19h30m

Note:—Sunset 15h 57m G.M.T.

If this explanation be correct, the life history of this gust is as follows:—

(1) The arrival of dry air (see humidities, Table 1) which led to a clearing of the sky over mountain and plain in north Wales.

(2) A steady fall of temperature, particularly after sunset at 16h. through radiation.

(3) A rise of temperature in the plain after 17h. caused by katabatic air from the near and lower levels of the Welsh mountains (see anemogram).

(4) The arrival at 19h. of still colder air from the more remote and higher levels of the mountainous regions, causing, presumably through subsidence, abrupt increases both in pressure and wind speed and an abrupt fall of temperature.

(5) A return to the general cyclonic conditions after this mountain air supply had been exhausted.

J. J. SOMERVILLE.

Discussions at the Meteorological Office

November 10th.—*Illumination from sun and sky in the neighbourhood of Stockholm in* 1928. By T. E. Aurén. (Stockholm Stat. Hydro.-Meteor. Anst. Medd. 5, No. 4. 1930.) *Opener*—P. I. Mulholland, B.Sc.

A considerable amount of attention has been devoted in recent years to the photo-electric recording of the light from the sun and sky. The photo-electric cell of an alkali metal is the practical application of the discovery made by Hallwachs in 1888 that a body carrying a negative charge of electricity rapidly loses that charge when exposed to ultra-violet light. In 1889 Elster and Geitel showed that the alkali metals exhibited the same effect when exposed to light in the visible spectrum. J. J. Thomson and P. Lenard showed that the action of the light was to cause the emission of electrons, and later Lenard and others showed that the number of electrons emitted was proportional to the intensity of the incident light, this proportionality being found to hold over a wide range of light intensities. This paper describes the apparatus employed by the author in which photo-electric cells in combination with sensitive galvanometers have been used to record photographically the variations in the intensity of the illumination received from the sun and sky on a horizontal surface at Stocksund (Sweden). A brief account is given of the characteristics and behaviour of photo-electric cells and the precautions that must be taken to ensure trouble-free and consistent operation.

The records cover a period of one year, 1928, and included amongst the tabular matter are tables which give in arbitrary units the relative amounts of light-energy received daily on a horizontal surface, and in addition hourly values for the months June to September inclusive. For approximate calculations in the more familiar unit of radiation, the arbitrary unit of Dr. Aurén may be taken as roughly equivalent to 0·4 gm.-cal. per cm.^{2} per min. Using this approximate relation, the daily amount of light-energy recorded during 1928 varied from 290 gm.-cal. per cm.^{2} on June 26th to 1·7 gm.-cal. per cm.^{2} on December 11th. For the year the total light-energy recorded amounted, roughly, to 38 per cent of the total radiation as recorded by an Ångström pyranometer. The mean relative illumination during 1928, or the ratio of the total illumination recorded to the illumination that would have been recorded had the sky been always clear, amounted to 65 per cent.

In the discussion it was pointed out that for the proper interpretation of the records it was desirable to have the spectral sensitivity curves of the cells employed, since it has been found that the response to light of a given wave-length differs for different cells of the same metal, and this fact makes the comparison of records from different places at present rather uncertain. The paper is a valuable indication of what is being done to extend our at present meagre knowledge of a subject of great importance in researches in human and plant physiology and climatological questions in general.

The subject for discussion for the next meeting will be:—

January 12th, 1931.—*Explosions for research purposes. Second communication. Results from October* 1*st*, 1926, *to March* 31*st*, 1929, *in Germany.* By H. Hergesell and P. Duckert (Lindenberg, Arbeit, Aeron. Obs. 16, 1929, D. pp. 1-32) (in German). *Opener*—Dr. F. J. W. Whipple, F.Inst.P.

Royal Meteorological Society

The opening meeting of this Society for the present session was held on Wednesday, November 19th, in the Society's Rooms, at 49, Cromwell Road, South Kensington, Mr. R. G. K. Lempfert, M.A., F.Inst.P., President, in the Chair.

J. Edmund Clark, I. D. Margary, R. Marshall and C. J. P. Cave.—Report on the Phenological Observations in the British Isles, December, 1928, *to November*, 1929.

In a year of extreme conditions the abnormalities largely cancelled out giving an " average year " : the cold of January and February compensated by the warmth of March and September: drought in spring by deluge in November. But the brilliant March sunshine, half as much again as usual, was more than match for the dullness of January, February and August. Winter migrants, such as fieldfares and redwings, fled from usual haunts to avoid the cold, but reappeared as welcome guests in south Ireland and southwest England. Sharp spells of cold in April, May and June neutralised the alarming number of queen wasps, so that few workers troubled the autumn fruits. In the table of flowering dates, all are late in England and Wales, though decreasingly so; from 17 to 14 days for the hazel and coltsfoot in February, to 1 and 2 days for the devil's bit, scabious and ivy in early August and late September. That the determining factor was cold of continental type spreading exceptionally in proportion to propinquity is well shown by the district values. England, E., for the seven early spring flowers, hazel to hawthorn, was 13 days late (hazel, 26); S.E., 12; Midlands, 10. But these plants were actually early in Ireland and Scotland, N., and only two days late in Scotland, W. Our earliest bird record, the song of the thrush, and the honey bee date for insects tell the same tale; the latter 12 days late in England, E., 4 early in Scotland, W. The exceptional nature of the March warmth and sunshine is as usual best illustrated by the insects with their quick response to weather conditions. On the average the queen wasp appears two days after blackthorn blooms; in 1929, ten days earlier. It was over a month early in Scotland, W., and the orange tip butterfly nearly as much in Scotland, E. The year's results in farm and garden as to quantity and quality showed a small balance on the credit side, due chiefly to the superb September. But to drought in the southeast was due a shortage of hay and straw, while in the far north, late comparatively in its harvest time, the October deluge played sad havoc.

A. V. Williamson, M.A., and K. G. T. Clark, B.A.—The Variability of the Annual Rainfall of India.

In this paper variability is defined as the percentage departure—irrespective of sign—from normal annual rainfall which has occurred at a given station in half the years of the period, 1890-1923. The importance of phenomenally extreme years is recognised, but not considered, the object being to portray characteristic, not exceptional, conditions. After a brief résumé of the geographical distribution of rainfall over India at different seasons two generalisations are submitted and illustrated, namely (i) the lower the rainfall the greater variability tends to be, (ii) rainfall is less reliable when it is characteristically concentrated than when it is well distributed in time. The paper then proceeds to discuss the map which accompanies it, and which shows India divided into zones by means of "lines of equal-variability." The desert to the northwest and the semi-arid core of the Deccan reveal the greatest variability, the former in particular. The west coast south of Bombay, Assam, Bengal and Orissa, are areas of abundant and reliable rainfall. Despite a good average rainfall, Gujarar and the central portion of the east coast of Peninsular India show an uncertainty rivalling that of the Central Deccan, and considerably in excess of Mysore and adjacent areas with only a very moderate but well-distributed precipitation. In conclusion, attention is paid to a recent paper by E. Biel, of Vienna (Die Veränderlichkeit der Jahressumme des Niederschlags auf der Erde); the authors compare their own results with those presented for India in that publication.

Asche Moe (Stavanger).—The North Sea as a link between climate, plant growth, and migration of birds, in the British Isles and in Norway.

Correspondence

Cyclones and Anticyclones

In his interesting letter in your October number Sir Napier Shaw suggests that the production of velocity in the atmosphere is a single problem and that pressure-difference arises as a consequence of the creation of velocity. (Horizontal velocity is implied, though not explicitly stated.) I venture, with some diffidence, to question the correctness of the "single problem" assumption.

Is it not reasonable, nay, probable, that the problem of the general motion of the atmosphere is quite different from the problem of a tropical revolving storm? Sir Napier would have us believe that the atmosphere does not move because it is pushed but pushes because it is moved. Does not the atmosphere do both? If I may use an analogy, a motor-car moves primarily because it is pushed, but it may execute gyrations because it is moving, even when the primary push is a thing of the past.

So in the atmosphere, I conceive a push, or pressure-difference, between equator and pole as the cause, and not the consequence, of the general motion; because such pressure-differences would exist even if every square metre of earth carried a column of air enclosed within vertical walls which prevented horizontal motion altogether. For the god responsible for these pressure-differences see *Paradise Lost*, Book IV, line 37—no doubt, like all wise gods, he has his helpers or intermediaries.

A familiar example, where motion is the cause and not the consequence of pressure-difference, occurs with a general north-west current sweeping across France and the Alps: a depression appears on the Gulf of Genoa: the pressure-difference would not arise in this case if every metre-square column of air were enclosed within vertical walls which prevented horizontal motion —the difference arises because the atmospheric motor-car meets an obstacle on the road and skids badly.

E. GOLD.

8, *Hurst Close, Bigwood Road, N. W.*11. *October* 19*th*, 1930.

Line-Squall, November 2nd, 1930*

I should like to give an account, as briefly as possible of a line-squall which occurred here yesterday, November 2nd, 1930.

When drizzle was falling from low-driving nimbus clouds with a squally SW. wind, a sudden peal of thunder occurred to the west. There was no sign of a storm, but a few minutes after the thunder occurred, which was about 10h. 15m. (G.M.T.), a long line of cloud appeared to the northwest low near the horizon. This line moved rapidly higher into the sky and was to be seen stretching from the north through northwest to west or west-southwest.

The line itself was merely an abrupt cessation of the low nimbus cloud who had previously covered the sky. Below the rather ragged edge of the line a uniform sheet of whitish-grey covered the sky. By 10h. 30m. (G.M.T.) the storm suddenly burst with a strong squally wind and torrents of rain. The actual squall only lasted five or more minutes, and one flash of lightning and peal of thunder occurred during its passage. After it was over, rain fell steadily from a uniform sky and the thunder became fainter to north or northeast, but later another flash of lightning occurred to southeast followed by a peal of thunder. One or two minutes later a very vivid purple flash was immediately succeeded by one of the most terrific crashes we have had this year. A house was struck by lightning in Oakhill Road, Surbiton, and I should not be at all surprised if this was the flash that caused the damage.

---

* See p. 249.

After a few more flashes and rumbles to southeast the storm passed.

The total rainfall collected during the storm was just over half an inch. One interesting feature I noticed during the storm was the very light wind which prevailed when the main thunderstorm was in operation. Pressure had fallen rather rapidly to 983mb. when the squall broke and the only interruption in the trace on the barogram was a temporary cessation of the fall. Temperature had risen to 56°F. in the " screen " before the squall, but fell 3° briskly on its arrival and two more later on; not such a large fall as has occurred here on many other occasions of squalls of far less intensity, so the squall here did not seem to have been caused by a burst through of polar air as I had suspected when it first came in sight.

K. G. WILLIS.

Lasham, Effingham Road, Surbiton, Surrey. November 3rd, 1930.

Damage by Lightning at Walpole Highway

Mr. C. Dann, of " Lyndhurst," Queens Road, Wisbech, sends us particulars of the damage to a house at Walpole Highway, about five miles from Wisbech, on the evening of October 25th. There was only a single flash of lightning, at 5.10 p.m., but this sufficed completely to wreck one side of the house. A chimney stack was felled, and more than half the roof was uncovered, slates flying in all directions. Some of the bricks were carried into an adjoining field, to a distance of 100 yards, and other bricks and slates were carried completely across the road. The plaster of the ceilings of an upstairs bedroom and of the sitting room below was brought down, the fireplaces of both rooms were blown out, as was the kitchen sink. The force of the explosion was evidently very great, and it is interesting to note that the son of one of the occupants saw what he thought was a fireball passing through the hall into the kitchen. Fortunately there was no loss of life.

Pen Reservoir With Delayed Ink Feed. Rounded Baxendell Pen

The delayed ink feed similar to that suggested by Mr. P. R.

Zealley* has been successfully used here for a number of years; in addition to the wick, a small light reservoir is soldered on to the pen holder, there being no elbow; the wick can then pass into the reservoir, where the ink level should not be above the point of contact between pen and chart. This method is used on the pressure-tube anemograph and Baxendell instruments satisfactorily.

Some time ago difficulty was caused on the Baxendell instrument when a northerly wind of moderate strength allowed the pen to dig into the chart as it crossed the overlap, usually resulting in a broken pen and damaged record. This occurred in damp weather and was overcome in the following manner. A " J " type of pen had its point filed off so that a curved contact with the chart was made. It is rather important in rounding the pen to shape it symmetrically either side of the pen slit, making the curve 1·0mm. radius. This allows the slit to make a point contact with the chart, and maintains the ink flow. Over-inking should be avoided. This pen, used with a reservoir and wick, was adopted here six months ago, and has not, except for inking, needed attention since.

W. Selway.

Meteorological Research Station, Leafield, Oxon. July 25th, 1930.

Weather of a Hundred Years Ago

Mr. Richard Cooke, of The Croft, Detling, Maidstone, has sent us the following extracts from " Old Days in Country Places. Notes from Diaries by Two Authors," by Cecil Palmer.

These diaries describe two villages—one quite in the north of Herefordshire and the other in the south of the same county—some 100 years ago.

Page 41. " ' I heard Langorse a-roaring,' said Mrs. Evans—Mrs. Evans lives on the edge of the common, and has lived there for fifty years. ' I heard it plain, and we'll have tempestuous weather I do know.'

" For the country people hereabouts have a belief that the sound of the wind heard here on a still day is Langorse Lakes, thirty miles away among the Brecon Hills, tempest-tossed, and that the sound surely foretells a storm. Some of them however call the sound the ' Hiren ' as I have said, and the learned may be able to tell me what spirit of the waste or weald this may be.

" Do the sheep know that wild foreboding voice? . . . . . but I do know that one night—a night with a soft west wind blowing gently and all things moist with thaw—a flock of Davy's mountain-bred sheep were down at the fold-gate, patiently waiting to be let in. ' What do ail the things,' said Davy, who always looked at the sky and ' folded ' his sheep if snow was imminent. He saw no sign of snow now and doubted the ' dumb ' creatures were wiser than he was. However he brought them in: and lo! he awoke the next morning to see a white world, and a fierce swirling north-west wind drifting the snow up the mountain gullies and bringing destruction to flocks less sagacious than his own." March 7th (unfortunately no date of the year given anywhere, but about a hundred years ago).

---

* See *Meteorological Magazine,* 65, 1930, p. 115.

Page 164, same book, quotes from " A Glossary of Provincial Words used in Herefordshire, published by Murray in 1839 "—

a "dabbledy" day for a wet day.
a " glemmy " day for a day of sunshine and cloud, a gleamy day.

Ancient Hindu Meteorology

Monsoon Prognostications.—The famous astronomer Varaha-Mihira is believed to have lived in the 5th century A.D. In his work entitled *Brihat-Samhita* (*i.e.*, the Big Compilation) he summarises meteorological knowledge handed down from the time of the *Upanishads.* The verses of the *Samhita* are very interesting. There is evidence to show that raingauges were known in ancient India and that more or less accurate observations of halos, twilights, thunder, lightning, winds, etc., were made and utilised for weather prognostications.

In Chapter 21 of this book the astronomer sets out the auspicious signs which herald a good monsoon. These are summarised below against months which correspond approximately to the Hindu lunar months in the *Samhita.*

October-November :	A red glow on the horizon in the morning and evening, clouds and halos; not severe cold.
November-December :	A red glow on the horizon in the morning and evening, clouds and halos; not too much snow.
December-January :	Strong wind, dim sun and moon, great cold, thick clouds at sunrise and sunset.
January-February :	Violent dry gales, thick clouds with smooth bases, broken halos, copper red sun.
February-March :	Clouds accompanied with wind and rain.
March-April :	Lightning, thunder, wind and rain.

These inferences are presumably based on observations at a number of places in the Indo-Gangetic plain.

According to Varaha-Mihira cloud observations for the forecasting of the subsequent monsoon rainfall should commence by the second fortnight of October, *i.e.*, the beginning of winter. The impregnation of the atmosphere with moisture begins in winter and the " rain-embryos " formed during each of the above months produce rain after 195 days. If most favourable conditions prevail in each of these months, the number of rainy days would be 8, 6, 16, 24, 20 and 3 in May, June, July, August, September and October respectively, *i.e.*, the wettest monsoon should consist of 77 rainy days.

It is interesting to note that in the very wet monsoon of 1917 there were 5, 6, 12, 15, 13 and 5 rainy days in each of the months May to October over the fertile plains of northwest India, giving a total of 56 rainy days in the season. The resemblance between the two sets of rainy days, ancient and modern, is remarkable. In ancient India a " rainy day " was defined to be a day on which sufficient rain fell to leave impressions on the soil or water-drops on the tips of grass blades. (Vide *Brihat-Samhita*, Chapter 23, Verse 3.) This amount is certainly less than 0·1in. of rain adopted by the Indian Meteorological Department as their lower limit of a rainy day.

Varaha-Mihira also states that if there is too much rain in the winter the subsequent monsoon degenerates into drizzles or, in other words, excessive rain in the winter is prejudicial to the subsequent monsoon rainfall over northwest India. It is a curious coincidence that some of the correlation coefficients in M. V. Unakar's recent paper (*vide* Sc. Note, Vol. 1, No. 6, Ind. Met. Dept.) should support this generalisation.

S. N. SEN.

Meteorological Office, Poona. August 29th, 1929.

In Dr. Sen's note above, one of the symptoms favourable for rainfall in July is " strong wind " in December-January. It is interesting to note that the strength of westerly upper winds in a layer of 3 to 7 Km. over Agra (14 years) bears a correlation coefficient of + 0·55 (probable error ± 0·13) with the subsequent July rainfall over northwest India. It should be noted that between December-January and July there is an interval of 195 days referred to in the note.

The symptoms for each month given in the note are of the nature of partial correlations as unfavourable conditions in any one month may vitiate the favourable influences of other months. A correlation coefficient of 0·55 is therefore significant enough to warrant further examination.

M. V. UNAKAR.

Meteorological Office, Poona. August 31st, 1929.

Range of Visibility in a Fog

With reference to Col. Gold's note on the above subject,* some experimental work has been done on this subject by the electrical research department of the Royal Aircraft Establishment (Report No. E.E. 347).

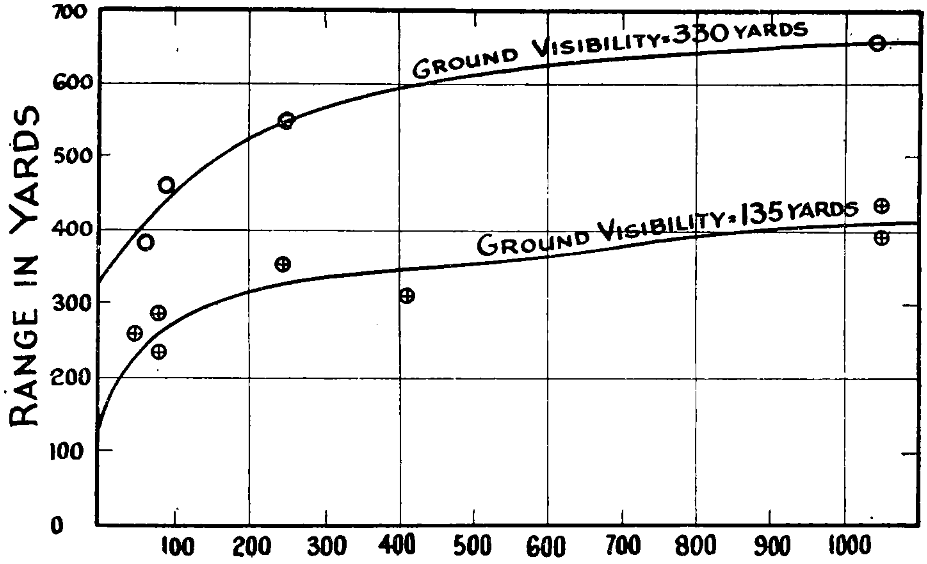
A light source was set up on a level straight road during foggy weather and the ranges corresponding to various inten-

---

*See *Meteorological Magazine*, 65, 1930, p. 11.

sities of illumination were measured for two different values 135 and 330 yards of ground horizontal visibility in daylight. A copy of the graph obtained is appended.

It will be noticed that the range increases rapidly at first with increase in light intensity, but that above about 1,000 candle power further increases only produce relatively small changes in range. With the latter source of light the daylight visibility is doubled in the case of fog of 330 yards, but is trebled in the case of fog of 135 yards' daylight visibility. A source of 100 candle power is sufficient to double the visibility in the latter case. Col. Gold's observations in Kingsway with a fog about 175 yards' visibility and a doubling of this by the light from a lamp would indicate an intensity of about 150-200 candles for this lamp. The incandescent gas lamp in the Finchley Road would probably be more of the order of 60 candles' intensity and would account for the doubling of visibility in a denser fog. In general, the denser the fog the less the intensity of illumination required to double the ordinary daylight visibility.



The observations are insufficient for the deduction of an equation connecting range and intensity, but for any given illumination the graphs appear to indicate that the range gradually approaches the ground visibility as the latter increases, and theoretically there should be a certain visibility above which the difference is small. This point is raised in connexion with the routine estimation of visibility as between day and night. At night, when observations of lights at fixed distances are often employed, there is a tendency to overestimate visibility on account of the factor of range. (The range of a light may be taken as being greater at night than in daylight.) As a consequence it might be expected during winter that estimates of visibility at 18h. during night time would be higher than those at 16h. in daylight. Observations during the current winter do not indicate this, the effect due to range probably being, at least above visibility F (1,000-1,200 yards), well inside the limits within which each letter lies. On most nights, however, one does get the feeling that visibility has increased with the advent of darkness.

The results of further tests by the Royal Aircraft Establishment to determine the ranges at which lights of different intensities and colours can be seen at night in conditions of bad visibility are awaited with interest.

W. H. BIGG.

South Farnborough. March 7th, 1930.

NOTES AND QUERIES

The Climate and Weather of the Middle Eocene in Western America

For a period of several million years a great mountain basin in Colorado and Utah was continuously occupied by a large lake, which for part of the time at least had no outlet. In the bottom of this lake, year after year, thin layers of sediment were deposited, until they aggregated 2,000ft. in thickness and formed a record which for the completeness and detail of the insight it gives into the conditions of formation, must be almost unparalleled. These deposits are known as the Green River formation, and Mr. Wilmot H. Bradley has now set out the results of his investigation into the climatic conditions of the time in a paper of great interest.*

The deposits consist of an enormous number of extremely thin laminæ, arranged in pairs, alternately brown and black. The author shows conclusively that each pair of layers, a fraction of a millimetre in thickness, represents the accumulation of one year, the brown layer, which consists mainly of mineral flakes and crystalline calcite, being probably formed in early summer, and the black layer, mainly organic, in late summer.

The lake, termed Gosiute Lake, occupied 12,300 square miles, and resulted from the drainage of 21,900 square miles. From several lines of argument, which give reasonably concordant results, the author concludes that the annual rainfall was between 30 and 43in., and approximately balanced the transpiration and evaporation. The rain probably fell in a long mild winter, while summer was dry and hot—there are heat cracks on the floor of the lake filled in by subsequent deposits. The mean annual temperature was about 65°F. For comparison it may be

---

*The varves and climate of the Green River Epoch *Washington, U.S. Geological Survey. Professional Paper,* 158-*E*, 1929.

remarked that at present the mean annual rainfall is about 10in. and the temperature at a height of 1,000ft. 58°F. The weather was normally quiet, for the material is so fine that it could not have been deposited so regularly in a shallow lake disturbed by storms.

The most interesting feature of the report concerns the rhythmic variations in the thickness of the annual layers. Three well-marked periodicities are found, having lengths of a little less than 12 years, 50 years and 21,630 years. The 12-year periodicity is plausibly attributed to the sunspot cycle of just over 11 years; it ranges from 7 to 18 years in much the same way as does the sunspot cycle. It is suggested by analogy with Lake Victoria that at times of sunspot minima Lake Gosiute was abnormally low and that for this reason as well as because of the higher air temperature associated with sunspot minima, it was abnormally warm, increasing the amount of both crystalline calcite and organic matter. The cycle of 50 years is predominantly one of rainfall and evaporation, for it is represented by layers of moulds of salt crystals.

The cycle of 21,630 years (from the 16 repetitions given, the length has a probable error of under 100 years) is shown by a repeated change from oil shale to marlstone, and the author suggests that a series of years with long cool winters and short hot summers would favour the formation of oil shales, poor in calcite but rich organically, while years with a more uniform temperature would favour the calcite and produce marlstones. This is just the succession which would result from the cycle of the precession of the equinoxes, which has a length of about 21,000 years but is highly variable. It seems probable that the author has discovered a real example of the effect of astronomical variations in changing climate.

C. E. P. BROOKS.

Notes on a Gale in Iraq

In his meteorological report for the month of January, 1930, Flight-Lt. W. J. Seward, who is in charge of the Meteorological Section, Air H.Q., Iraq Command, gave some notes on a storm which occurred at Hinaidi between January 5th and 8th. It was remarked by Col. Gold that the occurrence of a wind of an average velocity of 48 m.p.h. for an hour with a maximum gust of only 61 m.p.h. was sufficiently unusual to demand notice, and permission has been obtained for the reproduction of part of the Hinaidi anemobiagraph trace for January 6th. (See Plate facing p. 254.) In the notes Flight-Lt. Seward states: " This storm undoubtedly occurred as the result of a large depression moving eastward through the country to the southwest of Iraq. On nearing Iraq (on the afternoon of the 5th) the northerly portion of this depression took the form of an inverted V. In districts northeast of a line Rutbah—Abu-Ghar the winds freshened and blew from between ENE. and ESE. accompanied by showers. On the 6th the northern extremity of the inverted V had moved more northeast and rain was falling in most districts before dawn. At Hinaidi, at 6h. 30m., G.M.T., the wind on the surface was blowing from ESE. at an average velocity of 35 m.p.h. The wind gradually veered more SE. whilst the average velocity increased to 48 m.p.h. between 10h. and 11h., G.M.T. The maximum gust of SE. to E. 61 m.p.h. occurred at 10h. 47m., G.M.T., from 11h. to 12h. intermittent slight rain occurred. At 22h., G.M.T., on the 6th moderate rain commenced, and intermittent rain and drizzle occurred until 2h. 35m., G.M.T., on the 8th.

On the 7th the inverted V was detached from the southern portion of the depression. . . . This detached portion appeared to amalgamate with another low pressure system situated over eastern Syria; the combined depression then moved eastward into Persia on the 8th.

In the winter months depressions frequently move from the Cyprus region eastward across northern Iraq, Persia and Afghanistan when they give useful rains. These depressions, in crossing the Syrian desert, at times detach secondaries which pursue a more southerly track to southwest Persia.

Information for the full investigation of the depression in question is not available, but a few remarks may be of interest. The synoptic map for 8h. on the 6th given by the Egyptian Daily Weather Report shows a small depression centred near Beirut and another small depression indicated near Rutbah, about 250 miles eastward from Baghdad. Reports from R.A.F. meteorological stations show that at Rutbah the wind changed from ENE. force 3 (Beaufort) to W., force 6 between 6h. and 13h. G.M.T. on the 6th while a thunderstorm occurred from 6h. 30m. to 6h. 45m. At Diwaniyah, about 100 miles southsoutheast of Baghdad a moist wind from the direction of the Persian Gulf seems to have been replaced by a drier wind from a more southerly direction between 13h. G.M.T. on 6th and 2h. on 7th. Observations from Hinaidi are not available at the time of writing, but it seems probable that the air at Hinaidi on the 6th came originally from the Persian Gulf and travelled 340 miles up the low lying valley; the flat country and perhaps a slight convergence of flow due to the contours of the land near Baghdad may have accounted for the absence of ' land wind '* characteristics from the anemogram. Details of the upper air conditions at the time are not known. In the Persian Gulf itself, the alternation of strong southeasters (known locally as kaus) and northwesters (shamal) is a well-known feature of the winter season. It would be interesting to know if these names are in general use in Iraq also."

---

* See *Goldie, London Q.J.R. Meteor. Soc.* 51, 1925, p. 357.
Johnson, ,, ,, ,, 54, 1928, p. 179.

Meteorological-Aerological Station at Cape Guardafui

The following notification has been received from the National Geodetic and Geophysical Committee of Italy:—

" Attention has been repeatedly drawn to the advisability of establishing an aerological station at Cape Guardafui for the investigation of the upper air. It is now possible to announce that the said station is already fully active and meteorological and aerological observations have been carried out three times daily (at 7h., 13h. and 18h. G.M.T.) since January 23rd, 1930. The station is equipped with a barograph, thermograph, hygrograph and all the necessary apparatus for daily pilot balloon soundings, in accordance with the procedure at other similar Italian stations.

The daily recording of the observations is superintended by two Petty Officers of the Royal Italian Navy who have been attached to the Forecast Office for some days in order to follow a special course of instruction.

As the station has been established particularly with a view to transmitting the results of the meteorological and aerological observations to shipping and aircraft in that neighbourhood, the observations are broadcast three times daily at 7h. 30m., 13h. 30m. and 18h. 30m., coded in accordance with the international regulations.

The ' F. Crespi ' wireless transmitting set has been set up at Cape Guardafui. The observation records are submitted periodically to the Forecast Office, which provides for their working up and subsequent publication.

F. EREDIA."

Padua. 1930.

Review

Data of Heavy Rainfall over Short Periods in India. Ind. Met. Mem. Calcutta. Vol. XXV, Part III, pp. 109-143. 1929.

The title of the paper illustrates the difference in the climate of the British Isles and India, for instead of containing details of intense rains for a few minutes or at most a few hours, the information set out is that of the heaviest daily falls together with the amounts recorded on the preceding and following days. Only falls exceeding 10 inches are included, and many falls of more than 24 inches in a day are given. In the British Isles thunderstorm rains of an inch an hour are unusual, but in India this intensity is frequently maintained during monsoon rains for a day and more. The largest daily fall quoted is 38·33 inches (but as this is given as 35·33 inches in the preceding line, possibly the latter value only should be adapted, especially as this is still the largest in the table). The most remarkable run of wet days is that from June 14th to 16th, 1914, when 80·15 inches was recorded at Cherrapunji, Welsh Mission House. This is as much as falls in London during three years, and only about 3 per cent. of the total area of the British Isles receives this amount on the average in a year. The bulk of the entries occur, of course, in May, June, July and August. There are a number in September and October, but only one or two entries for January, March, April, November and December.

The information given in this memoir supplements that given in Volume XXI, Part III, up to 1911. The present memoir gives additional data up to the end of 1926, in a concise form for reference. Some 1,500 daily amounts exceeding 10 inches are quoted for the 15 years under review. During the whole history of British Rainfall no actual measurement of 10 inches of rain for a day has been made, although there are three occasions when this amount was probably exceeded, *viz.*, on November 12th, 1897, at The Stye, in the English Lake District; on July 3rd, 1892, at Langtoft, in East Yorkshire; and on August 18th, 1924, at Cannington, in Somersetshire.

J. GLASSPOOLE.

Obituary

Mr. Henry Alfred Rogers.—The announcement of the sudden death by heart failure of Mr. Henry Rogers on November 17th at his residence at 31, Fernbank Road, Redland, Bristol, will be received with great regret over a wide circle. In his early work as a commercial traveller, he learnt to read the signs of the sky and became a well-known local weather forecaster. His retirement through ill-health gave him leisure to read widely and to develop his hobby, and he wrote numerous articles in the Bristol press as well as contributing frequently to the correspondence columns of the *Meteorological Magazine*, while since 1920 he has observed rainfall regularly. As late as October, 1930, an interesting contribution on the subject of " Red Sunrises and Sunsets " appeared in our pages. Although in his 85th year, he was surprisingly active, playing bowls regularly, and one who saw him on the occasion of the British Association meeting at Bristol can fully endorse the description given to him as a " Grand Old Gentleman." Mr. Rogers was greatly delighted when the Bristol Meteorological Observatory was opened with an old pupil of his, Mr. G. H. Brown, as observer, and the station was approved by the Meteorological Office. We thank Mr Brown for sending these details and join with him in extending our sympathy to Mrs. Rogers in her bereavement.

News in Brief

Mr. J. A. Webster, C.B., D.S.O., has been appointed to the Meteorological Committee in place of Sir Henry McAnally, C.B., who has retired.

Mr. C. N. Knight has been appointed to the Meteorological Committee in place of Mr. L. V. Meadowcroft, who has retired.

Professor Dr. Wilhelm Schmidt has been appointed Director of the Central Institute of Meteorology and Geodynamics, Vienna, and Professor of physics of the earth at the University, Vienna, in succession to Hofrat Professor Dr. F. M. Exner, who died in February, 1930.

The Weather of November, 1930

November, 1930, was generally a wet month, mild in the south of the British Isles but cold in the north and west. The month opened with mild rainy conditions accompanied by mist and fog. On the morning of the 2nd, however, a violent squall line associated with a deepening depression crossed southern England, and some heavy thunderstorms were reported.* Rainy conditions continued in the southwest until the 6th and snow and sleet occurred in Scotland on the 3rd and 4th, but generally the weather became brighter and colder as a ridge of high pressure developed over the country. Sharp ground frosts occurred on the 4th, 5th and 6th, a minimum temperature on the ground of 12°F. being reported from Dumfries and Burnley on the 5th. On the 7th there was a change to westerly winds, strong in the north, with mild rainy weather; 2·17in. fell at Borrowdale (Cumberland), 1·26in. at Mount Callan (Co. Clare) on the 7th, and 1·10in. at Oban on the 8th. This was succeeded by a period of mainly dry anticyclonic weather in the south and east until the 13th, but the northwest came under the influence of the Icelandic depression, and though there was not much rain, gales and strong winds prevailed on many days. Records of sunshine were good on the 4th, 6th and 11th, while on the 14th places on the south coast again enjoyed over 8 hrs. of sunshine. Maxima reached 60°F. at places as far apart as York, Nottingham and Ross-on-Wye on the 9th, while 62°F. was registered at Waterford on that day. Behind a trough of low pressure, associated with a deep depression over Scandinavia which gave rain in Scotland on the 14th and general rain on the 15th, an anticyclone moved southeast across the country to the continent, bringing cold weather to all districts. During the squally weather accompanying the change on the night of the 14th a gust of 78 m.p.h. was registered at Birmingham and one of 74 m.p.h. at Scilly. Snow occurred in many parts of Scotland and the English Midlands, and sharp frost prevailed at night especially on the night of the 16th-17th, when a minimum of 17°F. occurred at Marlborough and of 18°F. at Rhayader and Eskdalemuir, while temperature on the ground fell to 7°F. at Rhayader and 9°F. at Burnley. Day temperatures were correspondingly low with local fog. At Renfrew the maximum did not rise above 29°F. on the 17th. In northern England the 16th was a sunny day. A mainly rainy period followed from the 18th to 26th with depressions moving northeastwards across the country; heavy rain fell in several districts on most days, except the 23rd which was sunny except in the southwest. The falls included 2·71in. at Fofanny (Co. Down) and 1·83in. at Holne (Devon) on the 23rd, 1·70in. at Llyn Fawr (Glamorgan) on the 24th and 1·65in. at Douglas on the 18th. Gales were frequently reported on various parts of the coast, and particularly in the English Channel. Snow occurred generally in Scotland on the 22nd, and there were local thunderstorms on the 21st, 22nd and 26th in England. From tht 27th to 30th improved conditions with a considerable amount of sunshine were enjoyed in the north and west, but in the south there was still much rain at times. The distribution of bright sunshine was as follows:—

---

* See page 249.

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs).
Eskdalemuir	60	+ 13	Liverpool	61	+ 2
Aberdeen	79	+ 24	Ross-on-Wye	71	+ 8
Dublin	75	+ 4	Falmouth	73	− 3
Birr Castle	57	+ 7	Gorleston	74	+12
Valentia	63	— 2	Kew	60	+ 8

Pressure was above normal over the Mediterranean, the greater part of the North Atlantic, Labrador, the whole of the United States, British Columbia, and Alaska, the greatest excesses being about 5mb. in Tripoli, south of Nova Scotia and at Barrow (Alaska). Pressure was below normal over Europe north of 45°N., including the British Isles and neighbouring seas, Iceland, Spitsbergen, Canada and western Siberia, the greatest deficit being nearly 12mb. in the Svealand and Norrland provinces of Sweden. Temperature was generally between 2°F. and 4°F. above normal over western Europe and 12°F. above normal at Spitsbergen, while rainfall was in excess generally over western Europe. In central Sweden the rainfall varied from 40 per cent to 80 per cent above normal, but fell to 20 per cent below normal in southeast and northwest Sweden.

Owing to the heavy rains the Seine was in flood at the beginning of the month, but had ceased to rise in Paris on the 11th. A landslide due to heavy rain in the neighbourhood occurred in the St. Jean quarter of Lyons on the 13th. Some minor landslides occurred on the Kilchenstock, in the valley of the Linth, Canton Glarus on the 21st and the following days, and the geologists reported that the Kilchenstock was then moving more than an inch a day. Its collapse may be hastened by the heavy rains. A landslide caused by heavy rains in the Loire districts occurred between Oudon and Anciens on the 21st. A violent storm accompanied by torrential rain swept over northern, central and western France on the 22nd, and many low-lying stretches of country and of the towns were flooded. The Seine continued to rise until about the 26th, then fell considerably, only to rise suddenly again on the 29th. Persistent rains caused floods in Belgium about the 22nd. The Rhine and its tributaries were also rising rapidly on the same day owing to storms, heavy rain and the quick melting of the snow. The storm in Germany on the 23rd did considerable damage, and many people were injured by a storm in Vienna on the 22nd. A strong Föhn wind was experienced in Switzerland on the 22nd and 23rd, causing the temperature to rise to 65°F. in the plains.

A typhoon of exceptional violence struck the islands of Pulo Condere, Indo-China on the 6th. Many people were killed and a number of fishing boats were sunk off the coast near Saignon. A cyclone struck the island of Kyaukpu, near Akyab, on the 10th, doing much damage, while a town on the island of Ramree was wrecked by a cyclone the same day.

During the first half of the month, temperature was below normal in the United States except in the Mountain Regions and along the Pacific coast, while rainfall was generally slight in the western regions and moderate in the eastern. During the later part of the month temperature was generally above normal especially in the northeastern regions, and rainfall was heavy locally at first, slight later. Many people were killed at Bethany, Oklahoma, on the 19th, when the town was struck by a tornado.

Severe gales were experienced on the North Atlantic early in the month.

The special message from Brazil states that rainfall was scarce in the northern and southern regions, being 0·39in. and 0·75in. below normal respectively, while it was plentiful in the central regions with 1·50in. above normal. Three anticyclones passed across the country but conditions were generally disturbed. The northeastern regions were suffering from lack of rainfall, but elsewhere the crops (except cocoa) were generally in good condition. At Rio de Janeiro pressure was 1·3mb. above normal and temperature 1·4°F. below normal.

Rainfall, November, 1930.—General Distribution

England and Wales	152	per cent of the average 1881-1915.
Scotland	134	
Ireland	110	
British Isles	138	

Rainfall: November, 1930: England and Wales

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Lond .	Camden Square.........	4·27	181	*Leics* .	Belvoir Castle...........	2·94	132
Sur .	Reigate, Alvington.....	5·05	162	*Rut* .	Ridlington...............	2·92	...
Kent .	Tenterden, Ashenden...	5·34	177	*Linc* .	Boston, Skirbeck........	3·06	153
,, .	Folkestone, Boro. San..	5·28	...	,, .	Cranwell Aerodrome...	3·09	165
,, .	Margate, Cliftonville...	3·63	151	,, .	Skegness, Marine Gdns	3·35	155
,, .	Sevenoaks, Speldhurst	5·22	...	,, .	Louth, Westgate........	3·65	142
Sus .	Patching Farm.........	5·92	166	,, .	Brigg, Wrawby St.....	3·10	...
,, .	Brighton, Old Steyne..	5·50	172	*Notts* .	Worksop, Hodsock.....	3·08	157
,, .	Heathfield, Barklye....	6·33	171	*Derby* .	Derby, L. M. & S. Rly.	2·91	135
Hants .	Ventnor, Roy. Nat. Hos.	5·11	159	,, .	Buxton, Devon Hos....	5·11	109
,, .	Fordingbridge, Oaklnds	5·76	169	*Ches* .	Runcorn, Weston Pt...	3·75	135
,, .	Ovington Rectory.......	5·72	172	,, .	Nantwich, Dorfold Hall	3·13	...
,, .	Sherborne St. John.....	4·70	165	*Lancs* .	Manchester, Whit. Pk.	4·34	164
Berks .	Wellington College.....	4·31	169	,, .	Stonyhurst College.....	6·02	133
,, .	Newbury, Greenham...	4·64	166	,, .	Southport, Hesketh Pk	4·81	153
Herts .	Welwyn Garden City...	4·36	...	,, .	Lancaster, Strathspey	4·82	...
Bucks .	High Wycombe..........	4·84	194	*Yorks* .	Wath-upon-Dearne.....	2·65	130
Oxf . .	Oxford, Mag. College..	4·20	190	,, .	Bradford, Lister Pk....	4·48	153
Nor .	Pitsford, Sedgebrook...	3·19	145	,, .	Oughtershaw Hall......	9·46	...
,, .	Oundle....................	2·59	...	,, .	Wetherby, Ribston H.	4·23	181
Beds .	Woburn, Crawley Mill	3·75	167	,, .	Hull, Pearson Park.....	3·54	162
Cam .	Cambridge, Bot. Gdns.	3·88	201	,, .	Holme-on-Spalding.....	2·86	...
Essex .	Chelmsford, County Lab	3·69	164	,, .	West Witton, Ivy Ho.	3·78	...
,, .	Lexden Hill House....	3·37	...	,, .	Felixkirk, Mt. St. John	3·62	148
Suff .	Hawkedon Rectory.....	4·30	189	,, .	Pickering, Hungate....	4·29	...
,, .	Haughley House........	3·33	...	,, .	Scarborough.............	4·43	179
Norf .	Norwich, Eaton.........	3·87	151	,, .	Middlesbrough..........	3·10	146
,, .	Wells, Holkham Hall	3·82	177	,, .	Baldersdale, Hury Res.	4·61	...
,, .	Little Dunham..........	4·00	154	*Durh* .	Ushaw College...........	3·63	143
Wilts .	Devizes, Highclere......	4·32	162	*Nor* .	Newcastle, Town Moor	2·71	112
,, .	Bishops Cannings.......	4·89	171	,, .	Bellingham, Highgreen	4·11	...
Dor .	Evershot, Melbury Ho.	7·13	167	,, .	Lilburn Tower Gdns....	4·29	...
,, .	Creech Grange..........	6·83	...	*Cumb* .	Geltsdale..................	3·92	...
,, .	Shaftesbury, Abbey Ho.	4·66	144	,, .	Carlisle, Scaleby Hall	3·83	128
Devon .	Plymouth, The Hoe...	6·86	188	,, .	Borrowdale, Seathwaite	14·25	105
,, .	Polapit Tamar...........	6·15	145	,, .	Borrowdale, Rosthwaite	13·37	...
,, .	Ashburton, Druid Ho.	9·06	160	,, .	Keswick, High Hill.....	6·73	...
,, .	Cullompton..............	6·11	178	*Glam* .	Cardiff, Ely P. Stn.....	4·94	118
,, .	Sidmouth, Sidmount...	4·80	154	,, .	Treherbert. Tynywaun	11·92	...
.	Filleigh, Castle Hill....	5·75	...	*Carm* .	Carmarthen Friary.....	5·56	112
.	Barnstable. N. Dev. Ath.	3·92	100	.	Llanwrda.................	7·21	122
Corn .	Redruth, Trewirgie.....	8·20	168	*Pemb* .	Haverfordwest, School	5·22	104
,, .	Penzance. Morrab Gdn.	6·53	142	*Card* .	Aberystwyth............	5·03	...
,, .	St. Austell, Trevarna...	7·98	162	,, .	Cardigan, County Sch.	4·97	...
Soms .	Chewton Mendip........	6·16	144	*Brec* .	Crickhowell, Talymaes	5·40	...
,, .	Long Ashton............	4·82	...	*Rad* .	Birm W. W. Tyrmynydd	8·14	122
,, .	Street, Millfield	3·63	...	*Mont* .	Lake Vyrnwy...........	9·77	175
Glos. .	Cirencester, Gwynfa....	3·72	125	*Denb* .	Llangynhafal............	3·92	...
Here .	Ross, Birchlea...........	3·67	145	*Mer* .	Dolgelly, Bryntirion...	8·97	145
,, .	Ledbury, Underdown..	3·49	143	*Carn* .	Llandudno...............	4·30	139
Salop .	Church Stretton.........	3·92	133	,, .	Snowdon, L. Llydaw 9	22·80	...
,, .	Shifnal, Hatton Grange	3·14	131	*Ang* .	Holyhead, Salt Island	4·68	113
Worc .	Ombersley, Holt Lock	2·63	115	,, .	Lligwy.....................	3·98	...
,, .	Blockley..................	4·05	...	*Isle of Man*			
War .	Farnborough.............	...	...		Douglas, Boro' Cem....	6·24	132
,, .	Birminghm, Edgbaston	3·28	138	*Guernsey*			
Leics .	Thornton Reservoir....	3·55	157		St. Peter P't. Grange Rd.	10·32	246

Rainfall: November, 1930: Scotland and Ireland

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt.	Pt. William, Monreith	5·19	...	*Suth* .	Loch More, Achfary ...	13·61	159
,, .	New Luce School......	5·58	...	*Caith* .	Wick......................	3·85	125
Kirk .	Carsphairn, Shiel.......	10·17	...	*Ork* .	Pomona, Deerness......	4·26	108
Dumf.	Dumfries, Crichton, R.I	4·09	118	*Shet* .	Lerwick	4·82	113
,, .	Eskdalemuir Obs.......	7·12	123	*Cork* .	Caheragh Rectory......	7·52	...
Roxb .	Branxholm	4·40	133	,, .	Dunmanway Rectory...	7·37	119
Selk .	Ettrick Manse..........	5·61	...	,, .	Ballinacurra.............	4·06	101
Peeb .	West Linton............	5·20	...	,, .	Glanmire, Lota Lo......	5·27	123
Berk .	Marchmont House......	4·38	146	*Kerry*.	Valentia Obsy..........	6·35	116
Hadd.	North Berwick Res.....	3·07	137	,, .	Gearahameen............	10·60	...
Midl .	Edinburgh, Roy. Obs.	3·81	177	,, .	Killarney Asylum......	5·65	101
Ayr .	Kilmarnock, Agric. C.	4·87	129	,, .	Darrynane Abbey.......	7·12	140
,, .	Girvan, Pinmore..	6·46	121	*Wat* .	Waterford, Brook Lo...	4·14	109
Renf .	Glasgow, Queen's Pk. .	4·46	120	*Tip* .	Nenagh, Cas. Lough...	4·05	101
,, .	Greenock, Prospect H.	8·84	138	,, .	Roscrea, Timoney Park	2·82	...
Bute .	Rothesay, Ardencraig.	7·21	142	,, .	Cashel, Ballinamona...	3·74	107
,, .	Dougarie Lodge.........	5·91	...	*Lim.* .	Foynes, Coolnanes......	3·95	97
Arg .	Ardgour House	14·36	...	, .	Castleconnel Rec.......	4·17	...
,, .	Manse of Glenorchy...	13·32	...	*Clare* .	Inagh, Mount Callan...	6·47	...
,, .	Oban......................	6·46	...	,, .	Broadford, Hurdlest'n.	4·29	...
,, .	Poltalloch	7·96	141	*Wexf*.	Gorey, Courtown Ho...	3·91	112
,, .	Inveraray Castle...	11·19	132	*Kilk* .	Kilkenny Castle.........	3·42	111
,, .	Islay, Eallabus.........	9·89	183	*Wic* .	Rathnew, Clonmannon	3·73	...
,, .	Mull, Benmore.........	15·90	...	*Carl* .	Hacketstown Rectory..	4·48	115
,, .	Tiree	5·65	...	*Leix* .	Blandsfort House......	3·41	102
Kinr .	Loch Leven Sluice......	4·10	114	,, .	Mountmellick............	3·89	...
Perth .	Loch Dhu...............	8·65	100	*Off'ly* .	Birr Castle..............	2·94	95
,, .	Balquhidder, Stronvar	6·62	...	*Kild'r*.	Monasterevin	2·82	...
,, .	Crieff, Strathearn Hyd.	3·80	88	*Dubl* .	Dublin, FitzWm. Sq...	2·34	87
,, .	Blair Castle Gardens....	4·30	122	,, .	Balbriggan, Ardgillan.	3·64	126
,, .	Glen Bruar, Bruar Ldg.	6·02	...	*Me'th* .	Beauparc, St. Cloud...	3·82	...
Angus.	Kettins School.	4·42	158	,, .	Kells, Headfort.........	4·03	118
,, .	Dundee, E. Necropolis	3·69	151	*W.M* .	Moate, Coolatore......	3·85	...
,, .	Pearsie House...........	4·04	...	,, .	Mullingar, Belvedere..	4·43	130
,, .	Montrose, Sunnyside...	3·57	135	*Long* .	Castle Forbes Gdns......	4·05	112
Aber .	Braemar, Bank.........	3·69	96	*Gal* .	Ballynahinch Castle...	7·83	131
,, .	Logie Coldstone Sch....	3·82	124	,, .	Galway, Grammar Sch.	4·66	...
,, .	Aberdeen, King's Coll.	3·53	120	*Mayo* .	Mallaranny..............	7·78	...
,, .	Fyvie Castle.............	5·08	...	,, .	Westport House.........	5·09	104
Moray.	Gordon Castle...........	4·42	153	,, .	Delphi Lodge............	10·73	...
,, .	Grantown-on-Spey......	3·99	133	*Sligo* .	Markree Obsy...........	4·58	110
Nairn.	Nairn, Delnies	4·96	210	*Cav'n* .	Belturbet, Cloverhill...	2·66	85
Inv .	Kingussie, The Birches	4·14	...	*Ferm* .	Enniskillen, Portora...	3·31	...
,, .	Loch Quoich, Loan.....	18·21	...	*Arm* .	Armagh Obsy...........	3·05	107
,, .	Glenquoich	17·86	147	*Down* .	Fofanny Reservoir......	8·83	...
,, .	Inverness, Culduthel R.	4·43	...	,, .	Seaforde..................	4·16	110
,, .	Arisaig, Faire-na-Squir	7·27	...	,, .	Donaghadee, C. Stn...	3·73	122
,, .	Fort William...........	9·39	...	,, .	Banbridge, Milltown...	2·91	...
,, .	Skye, Dunvegan........	6·86	...	*Antr* .	Belfast, Cavehill Rd...	4·77	...
R & C.	Alness, Ardross Cas ...	7·20	179	,, .	Glenarm Castle.........	6·92	...
,, .	Ullapool	8·44	...	,, .	Ballymena, Harryville	3·82	94
,, .	Torridon, Bendamph...	7·89	85	*Lon* .	Londonderry, Creggan	4·50	110
, .	Achnashellach..........	9·91	...	*Tyr* .	Donaghmore.............	4·92	...
, .	Stornoway...............	5·35	92	,, .	Omagh, Edenfel.........	4·40	116
Suth .	Lairg......................	6·60	...	*Don* .	Malin Head..............	4·74	...
,, .	Tongue	7·41	161	,, .	Dunfanaghy.............	4·90	...
,, .	Melvich..................	9·88	..	,, .	Killybegs, Rockmount.	5·49	87

Climatological Table for the British Empire, June, 1930.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb							
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1016·2	— 0·5	81	44	70·5	53·2	61·9	+ 2·7	55·1	80	6·3	1·31	— 0·84	6	7·6	46
Gibraltar	1015·0	— 2·4	85	53	76·0	59·7	67·9	— 2·6	60·0	87	4·9	5·86	+ 5·38	8	..	..
Malta	1014·6	— 1·0	88	65	79·4	67·6	73·5	+ 0·8	67·1	74	4·1	0·02	— 0·07	1	11·3	78
St. Helena	1016·6	+ 0·9	..	54	..	56·3	..	..	57·2	93	8·9	3·57	— 0·50	20	..	..
Sierra Leone	1013·9	+ 1·9	88	67	84·9	72·3	78·6	— 1·7	75·5	84	6·5	10·12	— 9·92	25	..	..
Lagos, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1017·6	+ 0·1	79	46	70·3	51·8	61·1	— 1·8	..	78	4·5	0·26	— 0·22	5	..	..
Salisbury, Rhodesia	1019·3	0·0	76	36	67·7	43·7	55·7	— 1·2	48·3	51	2·8	0·04	— 0·01	2	7·7	69
Cape Town	1022·4	+ 2·3	83	36	67·1	48·0	57·5	+ 1·8	48·6	85	4·4	0·65	— 3·85	8	..	..
Johannesburg	1024·9	+ 0·8	64	33	58·8	39·6	49·2	— 1·5	38·8	48	1·9	0·01	— 0·13	1	8·3	79
Mauritius	1017·2	— 1·8	79	56	75·7	62·8	69·3	— 0·1	65·7	69	4·8	3·72	+ 0·92	13	7·1	65
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	0·14	— 0·33	..	..	..
Calcutta, Alipore Obsy.	1000·8	+ 1·1	101	73	93·2	79·3	86·3	+ 1·2	80·1	85	7·8	8·59	— 3·31	13*	..	..
Bombay	1003·7	— 0·3	94	74	88·8	78·8	83·8	— 0·1	78·2	81	5·9	26·71	+ 6·84	17*	..	..
Madras	1004·0	+ 0·2	106	74	96·4	79·2	87·8	— 2·3	76·0	68	7·9	3·10	+ 1·21	5*	..	..
Colombo, Ceylon	1009·3	+ 0·6	87	71	84·9	75·7	80·3	— 1·4	77·5	83	8·9	13·34	+ 5·37	25	4·2	34
Hongkong	1007·6	+ 1·5	91	69	86·7	78·3	82·5	+ 1·1	78·1	78	7·9	12·25	— 3·84	20	7·2	53
Sandakan	..	..	91	73	88·4	75·0	81·7	0·0	77·2	83	..	7·27	— 0·03	13	..	..
Sydney, N.S.W.	1021·4	+ 3·6	69	41	61·7	51·3	56·5	+ 1·9	52·8	86	7·3	11·81	+ 7·04	21	2·7	31
Melbourne	1025·2	+ 6·7	68	34	58·2	43·2	50·7	+ 0·3	47·0	74	6·2	1·88	— 0·21	10	3·7	39
Adelaide	1025·0	+ 6·0	70	37	62·5	45·1	53·8	+ 0·3	47·2	67	6·2	1·11	— 2·04	8	5·7	59
Perth, W. Australia	1013·6	— 4·3	71	48	66·3	54·0	60·1	+ 3·3	55·6	79	7·3	11·35	+ 4·43	22	3·5	35
Coolgardie	1017·4	— 1·7	79	38	65·6	47·1	56·3	+ 3·6	51·3	75	7·0	1·37	+ 0·14	9	..	..
Brisbane	1019·3	+ 1·2	74	41	67·8	54·1	60·9	+ 0·7	56·2	75	6·4	7·58	+ 4·95	16	5·5	53
Hobart, Tasmania	1024·1	+ 9·8	63	32	52·2	39·9	46·1	— 0·7	41·4	77	5·5	1·17	— 1·03	12	4·3	47
Wellington, N.Z.	1017·9	+ 3·0	59	35	52·6	41·5	47·1	— 2·3	44·4	77	5·2	2·85	— 1·92	13	5·0	54
Suva, Fiji	1014·5	+ 0·9	85	61	78·6	68·1	73·3	— 1·6	68·8	75	6·2	5·09	— 1·06	15	5·0	45
Apia, Samoa	1010·5	— 1·1	87	69	83·9	73·6	78·8	+ 1·0	75·5	75	5·0	3·46	— 1·70	8	6·8	60
Kingston, Jamaica	1013·5	— 0·3	92	71	88·4	73·8	81·1	— 0·2	72·8	78	5·2	0·82	— 3·28	6	7·0	53
Grenada, W.I.	1013·5	+ 0·4	89	71	86·3	72·9	79·6	+ 0·7	73·9	77	7·5	11·85	+ 3·53	28	..	..
Toronto	1012·3	— 2·0	91	46	76·9	56·9	66·9	+ 4·3	59·8	73	4·9	2·43	— 0·33	10	8·9	58
Winnipeg	1009·6	— 2·9	87	37	74·8	53·3	64·1	+ 1·9	54·1	77	4·7	2·55	— 0·71	11	9·1	56
St. John, N.B.	1014·3	+ 0·3	87	37	67·0	50·9	58·9	+ 2·4	54·8	85	8·0	2·46	— 0·81	10	6·7	43
Victoria, B.C.	1017·2	+ 0·3	82	45	63·9	49·4	56·7	— 0·3	52·3	75	6·1	0·66	— 0·27	6	9·1	57

M.O. 326.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 65

Jan., 1931

No. 780

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:
ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH;
YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 15, DONEGALL
SQUARE WEST, BELFAST; or through any Bookseller.

Temperature Observations in Fog at Kew Observatory

By L. H. G. DINES, M.A.

Observations in fogs have been made at Kew Observatory by means of a small captive balloon and meteorograph from the year 1924 onwards. The methods adopted are described in Captain Entwistle's paper on Fog.* No summary of the data obtained has heretofore been published, and this note is based on an examination of a number of observations made during the winter seasons up to the present time.

The primary object of the observations has been to provide immediate information for the use of the Aviation Services Division as to the thickness of the fog layer existing, and to this end the record is examined as soon as possible after the balloon has been hauled down, a rapid estimate made of the probable height of the top of the fog and the result telephoned to London at once. In these circumstances minute consideration of the peculiarities of the records is not possible, and as it has been felt better to err on the safe side it has been customary to report the height at which, from a consideration of the record, it was certain there could not be any fog existing, rather than give a lower height about which there might be an element of doubt. It follows therefore that the data so obtained are probably somewhat higher than the actual tops of the fogs as they would have been seen from a manned balloon.

---

* *Aeronautical Reprints.* No. 28 Royal Aeronautical Society.

(92436) P.S.14/89 1,050 1/31 M. & S. *Gp.303*

In trying to measure the temperature and relative humidity at different levels on the occasion of a fog the main difficulty is connected with the sluggishness of the recording instruments. In foggy weather inland the wind at all levels in the fog is always very light, so that the natural ventilation of the meteorograph is poor. To compensate for this it is necessary to prolong the duration of the observation, and by so doing, reasonably accurate estimates of the temperature can be obtained. The measurement of the relative humidity, however, presents greater difficulty; this is unfortunate from the present point of view, because upon it largely depends the accuracy with which the true upper limit of the fog can be determined. A hair hygrograph is sometimes very sluggish in its response to changes in the relative humidity, and the degree of sluggishness seems to be by no means a constant quantity. The standard method of observation has been to allow the balloon to rise as fast as possible and then to pull it down again very slowly, basing all data on the record made during the descent. As the balloon comes down and the height above the top of the fog decreases, the relative humidity commonly shows a steady increase, but owing to the uncertain lag it is almost impossible to decide at what precise point the saturation of the fog was reached.

Results.—The changes of temperature with height generally take the form of a marked inversion, which has always been assumed to be situated near the upper limit of the fog. Originally the meteorograph was not provided with any cover, and if the sun were shining it could heat up the thermograph freely; the question was raised as to whether the inversion might not be largely fictitious and mainly due to insolation. Since the winter of 1928-9 a polished cover has been used which greatly reduces such a possibility, but large inversions have still been found, though not perhaps quite so large as was formerly the case. It is not always possible to raise the meteorograph to the top of the inversion and therefore the magnitude of the latter cannot always be measured precisely, but judging from data obtained since the polished cover was fitted the mean value must exceed 10°F. and the maximum may reach 17°F.

It is now quite clear that the inversion is a real phenomenon, but for the reasons which have been stated above it is difficult to correlate the changes of relative humidity with it, and it is in particular not easy to say whether the inversion takes place entirely above the limit of the fog, or whether there is sometimes an inversion inside the fog.

At first it was tacitly assumed that the latter might occur, though from the physical point of view it seems improbable; the upper limit of the fog was then assumed to be near the upper part of the inversion, not at its base. This procedure had the merit of safety for the purpose in hand, in that it denoted an upper limit beyond which the observational evidence of relative humidity commonly gave good reason for thinking that the fog did not exist, but further examination of old records suggests that it is not correct; it now appears much more likely that the upper limit of the fog is reached near the base of the inversion. The latter conclusion was reached mainly from a consideration of two specific occasions, viz., October 6th, 1927, and December 4th, 1925, when it happened, either by accident or design, that the balloon in its descent through the region of the inversion was periodically allowed to rise a little again before continuing its descent. On the latter occasion the traces of height, temperature, and relative humidity all oscillate in unison right through the inversion, effectively disposing of all question of lag of the hygrograph: in the former the oscillations though less pronounced are still there, and it is clear in both cases that saturation was not reached till some point near the base of the inversion. Further evidence to the same end is provided by the fact that apparently in no recorded case has the hygrogram indicated saturation on the descent before the base of the inversion was reached, or nearly so. These conclusions suggest a modification of the routine of observation for the future, which will largely get over the difficulty occasioned by the lag of the hygrograph. See *Appendix.*

Below is given a table of the heights of the upper limit of fog as estimated at the time on a number of occasions when observation was made at Kew Observatory. In studying it two points have to be remembered; firstly, that nearly all the observations were made at about 10 a.m., that is after the sun had risen, so that it is probable that the fog had been a little thicker at an earlier hour. Secondly and against this is the fact mentioned above that there has been apparently a systematic tendency to place the top of the fog somewhat too high. Perhaps therefore we shall not be far out in stating that the maximum thickness of fogs at Kew Observatory is approximately indicated

Date	Height of top of fog ft.	Date	Height of top of fog ft.
January 4th 1924	950	February 22nd 1928	320
,, 30th ,,	300	,, 23rd ,,	above 950
December 10th ,,	375	October 3rd ,,	150
,, 11th ,,	650	November 5th ,,	150
January 12th 1925	above 700	,, 6th ,,	600
December 4th ,,	600 at 10h.	,, 10th ,,	250
,, 4th ,,	525 at 14h.	December 18th ,,	750
November 25th 1926	400	November 15th 1929	700
February 11th 1927	750	,, 18th ,,	750
,, 14th ,,	600	February 14th 1930	650
October 6th ,,	500	December 5th ,,	950
November 8th ,,	700	,, 6th ,,	1,050
,, 22nd ,,	800	,, 9th ,,	400
,, 26th ,,	350		

by the figures in the table. It is definitely noticeable that very few fogs indeed exceed a thickness of 1,000 ft., the average being about 570 ft.

A fall of temperature in the air from the ground upwards in a fog is a very common feature, but not universal. It does not extend to the top of the fog and the lapse rate is generally less than the dry adiabatic, but on one occasion (October 6th, 1927) apparently a lapse rate of about that magnitude was indicated over a layer 200 ft. thick. It must be remembered that the temperature changes to be measured are so small that the instrument is not capable of providing data accurate enough to decide such a point, unless the routine of the observation were specially designed to that end, which has not so far been done.

Appendix.—It is probable that more precise information of the changes in relative humidity above a fog can be obtained by modifying the method of using the balloon and meteorograph. It is proposed to adopt the following procedure for trial in future:—

(1) Send the balloon up as rapidly as possible to the maximum height.
(2) Pull back again at about the rate of 250 ft. per minute.
(3) Examine the record and note approximately the height of the inversion, if any.
(4) Send the balloon up again as fast as possible to a point above the upper limit of the steep negative lapse rate and leave it at that height for about four minutes.
(5) Wind it in at about 120 ft. per minute for one minute, let it out at once about 40 ft. in half a minute, wind it in again for one minute, let it out 40 ft., and so on, till the observer is reasonably sure that he is through the inversion, then wind steadily home at about 120 ft. per minute.

The Significance of Nephoscope Observations

Although observations of upper cloud movements are regularly taken as routine observations whenever the opportunity presents itself, at the moment the significance of the upper cloud movements as indicating the upper winds are not by any means fully understood. Douglas* has mapped the upper wind circulation for a typical Norwegian cyclone, while the tabulations given by Pick and Bowering† indicate that neither the direction or speed of the upper clouds provide the forecaster with altogether reliable information as to the subsequent movement to be expected from the depressions with which the upper winds are associated.

---

*London, *Q.J.R. Meteor. Soc.*, 48, 1922, p. 342.

†London, *Q.J.R. Meteor. Soc.*, 55, 1929, p. 71.

As to their bearing on the subsequent behaviour of anticyclones there appears to be even less information. In the British Isles, where there is very marked preponderance of SW to W winds at the higher levels, it is only infrequently that very marked changes in direction occur and help to focus attention on their significance.

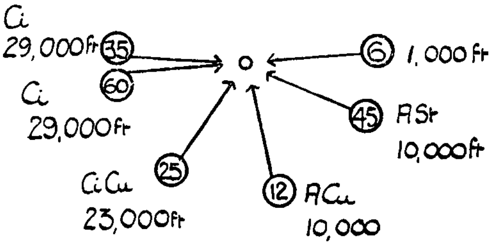
For this reason the changes in the upper winds during the period September 30th to October 2nd are of interest when considered in relation to the changes in the surface pressure distribution, and it is the purpose of this note to set out, side by side, the relevant details of the two. sets of changes.

For several days previous to September 30th, a large intense anticyclone had been maintained between Scotland and Iceland with little change. The distribution was associated with considerable low cloud, particularly over eastern and southern England, although on September 30th a few nephoscope observations of high cloud were possible. Fortunately these were widely distributed and showed, in conjunction with other data, a solid easterly current of moderate strength from the surface up to the cirrus level. Evidence of this sort that the anticyclonic circulation extends to great heights is generally accepted as an additional indication that the distribution is stable, although in this case a secondary centre off Portugal to a large low-pressure area between the Azores and Spain was definitely encroaching northwards. Late that same afternoon, however, an isolated nephoscope observation from Mount Batten, Plymouth (the observation was subsequently confirmed) showed that the wind at the cirrus level had in the space of a few hours changed to southwest and was blowing at 90 m.p.h.

There was no important change at the alto-cumulus levels on the following morning (October 1st), and at 7 a.m. the alto-cumulus at Valentia and at Rennes (Brittany) was from east-southeast. But by 10 a.m. the alto-cumulus at Tours was moving from 230° at a speed of 42 m.p.h., although the secondary disturbance was swinging northeast and the surface observations showed that it was no longer a source of potential danger to western and southern Britain. At 6 p.m. on the same evening the cirrus movements at Calshot were from a little north of west, while the surface observations indicated rather a southeastward extension of the anticyclone, more than any general movement of the system.

On the morning of October 2nd the main anticyclonic centre was definitely being transferred southeastwards towards Germany, more by a very marked increase of pressure in that area than by a definite movement of the system as a whole, since an intensive ridge was still maintained to the south of Iceland and westward to mid-Atlantic. By 10 a.m. the thick low cloud sheet over east and southeast England was breaking up, revealing a wealth of higher cloud strata of which observers were quick to avail themselves. It is interesting at this stage to digress somewhat and deal in more detail with the observations over south-east England, since they not only bear on the general situation but they also give a very complete picture of the air currents from the surface up to the cirrus level, which is not often so clearly indicated.

The relevant observations which are given in detail below include the pilot balloon ascent at Croydon and 5 nephoscope observations, the whole showing a continued and complete veer of the wind through 180° from a light easterly wind at 1,000 feet to a strong west wind at the highest cirrus level. In the diagram the winds at the various levels are represented by the arrows which blow with the wind, the speeds being shown in m.p.h. in the circle on the tail. The average height of the cloud types observed are also shown for reference :—

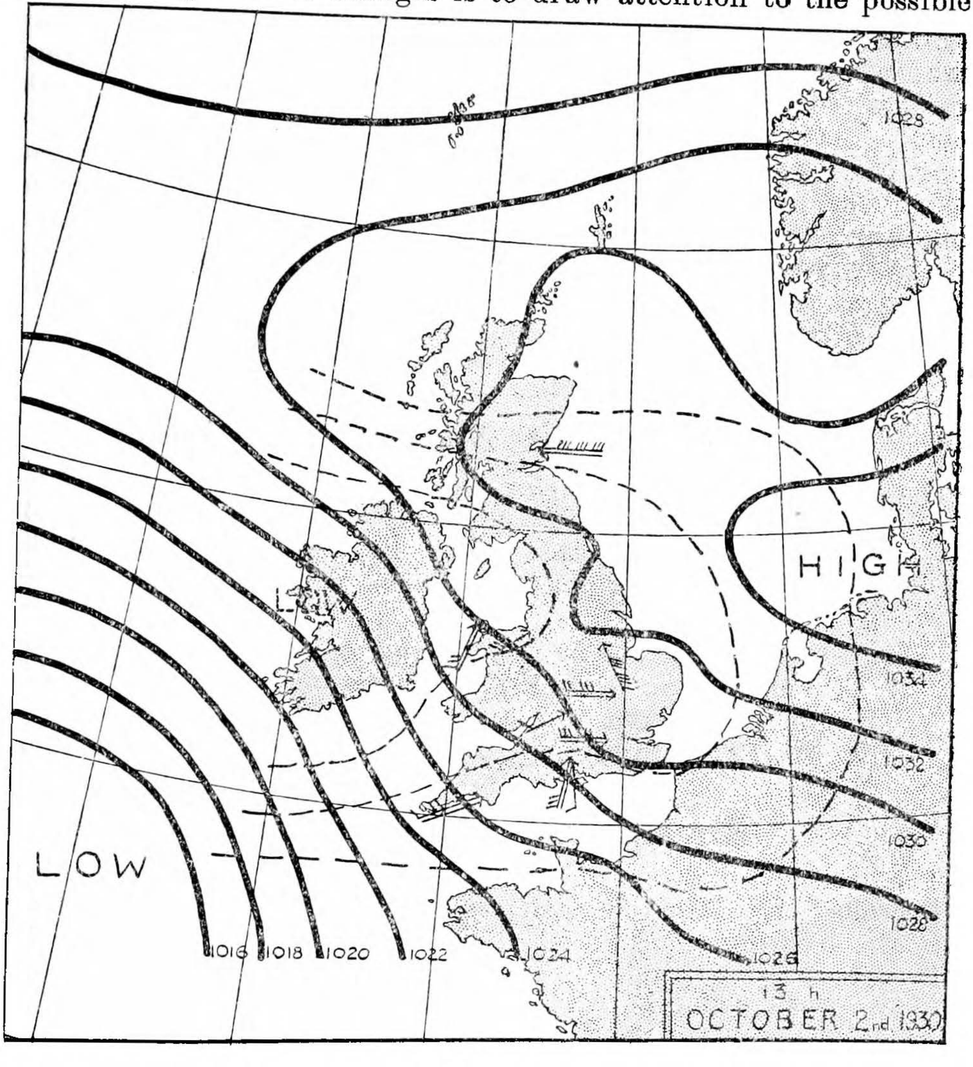


Croydon	pilot balloon ascent, wind from 80° at 6 m.p.h. at 1,000 feet.		
Felixstowe ...	neph.	alto-stratus	from 120° at 45 m.p.h.
Worthy Down ...	neph.	alto-cumulus	from 160° at 12 m.p.h.
Worthy Down ...	neph.	cirro-cumulus	from 220° at 25 m.p.h.
Croydon	neph.	cirrus	from 260° at 60 m.p.h.
S. Farnborough...	neph.	cirrus	from 270° at 35 m.p.h.

The anticyclone was now definitely moving southeast and by 1 p.m. the centre was over eastern Germany, and as the 10 a.m. nephoscope observations show, the westerly component was making itself felt at much lower levels over southern England. Over Scotland, however, a nephoscope observation of cirrus at Leuchars (Fifeshire) at 10 a.m. showed that in the highest levels there the wind was still due east. By evening the upper winds over southern England, at least down to the alto-cumulus level had become generally southwest to west, and thereafter the process of replacing the easterly winds by westerly winds at still lower levels continued uninterruptedly during the subsequent period. The outstanding change in the surface distribution at this stage however was not the mere withdrawal of the high pressure centre, but the rapid decay of the whole intensive anticyclonic system indicated at the surface by the marked and sustained fall in pressure over practically the whole of Europe which set in during the morning of October 3rd.

The chart reproduced is that showing the surface distribution at 1 p.m., October 2nd, and with it has been incorporated a selection of the nephoscope readings taken between 9 a.m. and 1 p.m. on that date. Single arrows refer to Alto-type clouds and double arrows to Cirro-type clouds; the speed is indicated by the number of flèches. An indication of the probable pressure distribution at the cirrus level is superimposed.

It is not to be expected that one particular case such as this can, of itself, provide even a useful clue to the problems confronting us, and the only object in setting out the foregoing detailed sequence of changes is to draw attention to the possible



significance of the upper wind changes. Apart from considerations of the temperatures of the various air masses involved and their admitted relation to the wind in the higher levels of the troposphere, one feels that the pressure distribution at these levels as indicated by the winds aloft should not be overlooked. In this case, as late as the morning of October 2nd there was definite evidence that the east winds still prevailed at the highest levels across northern Britain, although for the past 36 hours westerly winds had been indicated at the cirrus level over southern England. We have thus evidence of at least a low-pressure trough, if not a complete cyclonic circulation, at a height of approximately 29,000 feet superimposed on an equally definite anticyclonic distribution at the surface, while later events rather suggest, in a way, the propagation downwards of the high level "depression," if the term is applicable in the usual sense. Was the upper "trough" or "depression" an initial stage of the shallow low-pressure system on the surface which covered the country before the advance of a more vigorous system from the Atantic destroyed its identity? There is little doubt that the true position is that expressed so concisely by Sir Napier Shaw in the October number of the *Meteorological Magazine* and less explicitly by Capt. Douglas in the previous number "that anticyclones and cyclones are not two problems but two aspects of a single problem," and that the solution of many of the problems of meteorology will be found not in the study of either depressions or anticyclones separately but in a combined study of the two systems as one complete whole.

F. H. DIGHT.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings will be :—

January 26th, 1931.—*Outlines of a dynamical climatology.* By Tor Bergeron (Meteor. Zs. Braunschweig, 47, 1930, p. 246-64) (in German). *Opener*—Mr. S. T. A. Mirrlees, M.A.

February 9th, 1931.—*The flights and attempted flights across the North Atlantic in* 1927 *from the meteorological aspect.* By Ph. Wehrlé and A. Viant (Paris, Off. Nat. Météor., Mem. No. 19, 1928) (in French). *Opener*—Mr. J. S. Farquharson, M.A.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, December 17th, in the Society's rooms at 49, Cromwell Road, South Kensington, Mr. R. G. K. Lempfert, M.A., F.Inst.P., President in the Chair.

The Buchan Prize of the Royal Meteorological Society for 1931 has been awarded to Charles Ernest Pelham Brooks, D.Sc., for papers contributed to the *Quarterly Journal* and *Memoirs* of the Society during the years 1925-9.

John Glasspoole, M.Sc., Ph.D.—Heavy falls of rain in short periods (*two hours or less*).

A knowledge of the frequency of occurrence of unusually heavy rains is of considerable practical importance, especially in the design of sewers for the discharge of flood water. Schemes for the disposal of flood water are costly and the engineer has to balance probability delicately against possibility, and to seek the solution which will give a reasonable degree of immunity from flooding at a reasonable cost. The paper gives details of intense falls in 10, 15, 30 and 60 minutes as recorded in seven years at 14 stations distributed over the British Isles. This is a more detailed examination than has been carried out previously. The paper shows, for example, that at Camden Square (London) ·16 inch or more has fallen in 10 minutes on 22 occasions in seven years, and that on the average of the 14 stations ·80 inch or more has occurred in an hour once in seven years.

It is often reasonable to provide for all except the two or three highest storms during seven years, and details are therefore given, of the heaviest, second heaviest and third heaviest rains in specified times at each station. A summary is included of earlier work on the subject. A very full discussion followed the paper, showing the interest with which it was received, especially by water engineers.

M. T. Spence, B.Sc.—*The factors affecting visibility at Valentia Observatory.*

This paper analyses by means of frequency tables the relationship at Valentia between visibility and (*a*) cumulus cloud, (*b*) wind force, (*c*) humidity. It is found that visibility is better when there is cumulus cloud in the sky than when there is not, that visibility deteriorates with increasing wind force and improves with decreasing relative humidity down to comparatively low values of humidity. The relationship between visibility and cumulus cloud is regarded as showing that visibility at Valentia is generally better in air of polar origin than in air of equatorial origin : further support for this view is derived from a paper by Dines and Mulholland in which it was shown that northerly winds gave generally better visibility than southerly winds at Valentia. The deterioration of visibility with increasing wind force is not due to the stronger winds being land winds, nor to their being more humid than the lighter winds; it is concluded, therefore, that sea spray, the amount of which varies with wind force, gives rise to the greater obscurity with strong winds. It is suggested that improving visibility with drier air at comparatively low values of relative humidity may be associated with slow evaporation from the hygroscopic nuclei.

Correspondence

To the Editor, *The Meteorological Magazine.*

Glazed Frost ?

At Golders Green this morning the water deposited from the fog on trees, shrubs, twigs, had frozen. The resulting ice was quite transparent. It was not a continuous coating, but just drops like frozen dewdrops. The drops looked exactly like water, and one could only tell that they were ice by actually touching them.

The temperature on an openly exposed thermometer was 31°F. I do not know what the correction to the thermometer is: it is probably small. Usually when ice is deposited from fog it is rime and white. I do not know whether this water was deposited as water and froze afterwards, or whether it was actually deposited from super-cooled drops. I rather suspect the former, but the immediate point which arose was—is this glazed frost?

E. GOLD.

December 5th, 1930.

[I once saw the same phenomenon on head grass-stalks by the side of the path leading to Kew Observatory, and was much struck by it at the time. I recollect the circumstances quite clearly, and the appearance was exactly as described above. In particular I am quite certain that there was no continuous coating of ice.

The definition of "glazed frost" in the *Observer's Handbook* lays stress on the presence of a "smooth coating of ice covering trees, etc.," and it is doubtful, therefore, whether the phenomenon could be fairly described as glazed frost. On the morning in question glazed frost was reported at Harrow, so one might perhaps deduce that glazed frost is a more advanced stage of the phenomenon.—E. G. BILHAM.]

A Super-cooled Cloud

A sounding balloon sent up from Kew Observatory at 18h. on September 27th last yielded an interesting example of a cloud of supercooled water drops. The recording instrument was fitted with a hair hygrograph and the record shows that it entered a dense cloud at a level of about 2,000 dynamic metres (2,040 metres), the temperature being about 271°A. The thermograph evidently became covered with a layer of water, which remained unfrozen till the level of 2,750 dynamic metres was reached with an air temperature of 266·5°A. At that point the water suddenly froze, bringing the apparent temperature up instantaneously to 272°A. Almost immediately afterwards the balloon emerged from the cloud and the thermograph, wholly or partially covered with ice, must have functioned somewhat like a wet bulb. The record shows definite signs of this, and there is further evidence that the ice soon evaporated in a dry region above the cloud.

It is interesting to have this evidence of a supercooled cloud and that water can collect on a solid body without freezing down to as low a temperature as 6·5°A. below the freezing point.

L. H. G. DINES.

Kew Observatory, Richmond. November 19th, 1930.

Peculiar Cloud Phenomena

I was much interested in the note under the above title on page 215 of your October issue. Was this not a sort of " waterspout " on land? The description seems to tally so well with what we saw from this island when looking in the direction of Naples on the afternoon of September 15th.

In that case the evil-looking parent cloud was a long one, covering perhaps ten or fifteen miles, very slowly drifting in an easterly direction, although there was over all the surrounding sea at the time practically a dead calm. The black shafts descended in four different places, at intervals of a few miles, and we were at first struck by what we took to be just a rain storm concentrated in such a small pour. But then below it was seen to be a white disturbance in the sea reaching up to join with the black arm descending from above. The black thing was in each case just like the sleeve of a giant's coat without the hand showing, rather like an elephant's trunk, as your observer describes his.

The whole performance took about a quarter of an hour or twenty minutes. The black cloud seemed to contemplate other descents which failed to mature, and drifted along towards Naples and Vesuvius coming from a westerly direction.

M. Rawnsley.

Dil-Aram, Anacapri, Italy. November 7th, 1930.

Waterspout at Cape d'Aguilar Wireless Station, Hongkong

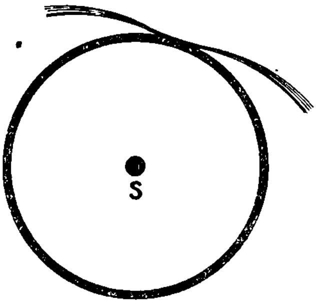
At 10.30 a.m. on September 29th, a waterspout was observed in the bay near the pier at Cape d'Aguilar. The spout and spray were in a column about 50 feet in diameter and 200 feet high when first seen by Mr. Merriman and myself. The station and quarters were hurriedly secured in readiness, but the whirlwind on reaching the shore travelled slowly to the O/C.'s bungalow carrying with it some seaweed, branches, and actually a few fish. On reaching the bungalow the whirlwind paused and halted short of the front door. It then turned, skirted around the house without touching it, and on its way across the back garden raised the dustbin vertically to a height of about 50 feet and carried it slowly into the bay on the Shek-O side of the station. The whirlwind then climbed the side of d'Aguilar Peak in a northwesterly direction.

J. Key.

Cape d'Aguilar Wireless Station, Hongkong. September 29th, 1930.

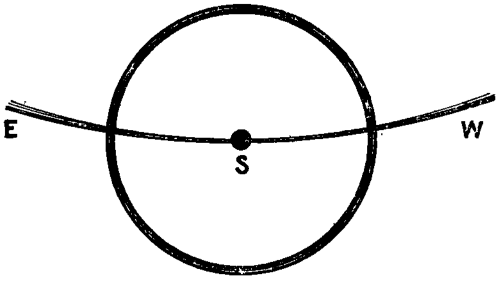
Halo Phenomena

On Sunday, October 19th, 1930, at 11.15 (G.M.T.) a faint halo of 22° was visible with a bright inverted contact arc a little to the west of the zenith of the halo, with its ends curved down towards it. By 11.40 the ends had become less curved, forming a more or less straight band, but still retaining the inward curvature. The intensity of the whole phenomenon varied with the amount of cloud covering that portion of the sky, the halo of 22° increasing in brightness as cloud increased. The prismatic colours at the junction of the arc and the halo were unusually bright, especially when first noticed, with a thin film of cirro-nebula covering that portion of the sky. (No apparent parhelion was observed at the contact arc.) The arc attained its maximum brightness with the highest type of cloud, namely, cirro-nebula, which first made its appearance as a whitish haze at about 11.15 but decreased with the advance of a lower stratum of cirro-stratus from the south-southwest.



11·15

By 12.00 the whole phenomenon had almost disappeared except the bright junction of the arcs which were now much less intense. By 12.15 no trace of a halo could be seen although the sky in the vicinity of the sun appeared to be clearer than at 11.40, but this may have been accounted for by a lower type of cirriform cloud which did not give rise to halo phenomenon, the cirro-nebula having temporarily cleared away.



12·50

At approximately 12.50 an arc of a white parhelic circle passing through the sun and extending towards the east and west was visible together with a faint halo of 22°, but both became rapidly obscured by a layer of cirro-cumulus cloud, the parhelic circle being visible through the cloudlets until a thicker stratum of cirro-cumulus completely covered the whole southern portion of the sky. The sun was again visible as a faint blur through stratus at 13.30, but no halo was visible except a faintly coloured corona, and rain was just beginning to fall from an increasing lower stratum of cloud. The wind was mainly light from a southeasterly direction during the morning and continuing so throughout most of the day.

The whole of the above interesting formations were observed with a black mirror, a very excellent means of observing halo phenomena. I am only an amateur observer, but noticing these very interesting phenomena I thought that it might be of interest as from this district. The two diagrams, taken from sketches drawn while observing the phenomena give a slight idea of the appearance of the halos. A. Moon.

39, *Clive Avenue, Clive Vale, Hastings. October 21st,* 1930.

Cyclones and Anticyclones

In the October, 1930, number of the *Meteorological Magazine* Sir Napier Shaw makes some interesting remarks about the production of velocity in the atmosphere. In this connexion, the atmospheric waves which circulate in the southern hemisphere would, in my opinion, well repay detailed study by European meteorologists. The more experience one has in these regions the more impressed does one become with the regularity of this feature of the general circulation. The cyclone has played far too prominent a part in meteorological literature. Even Sir Napier Shaw says that " a cyclone will be dug on the left-hand side . . . . . of any current of air in the atmosphere except indeed at the Equator." That seems to me to be far too sweeping a statement. Edward Kidson.

Meteorological Office, Wellington, New Zealand, November 24th, 1930.

NOTES AND QUERIES

"Flattish" Hailstones Observed in Thunderstorm over Mt. Olympus, Cyprus

At Cyprus on September 12th, 1930, flat and other peculiar-shaped hailstones were observed by numerous spectators up Mt. Olympus, about 6,000 ft. above sea level.

During the early part of the day the weather showed no unusual symptoms, being fine during the forenoon with a moderate southerly breeze at sea level. During the forenoon slight cumulus cloud commenced to form over the land, principally on the westward side. One observer stated that at about 14h. (East European time) he was sitting inside a tent when he noticed a roaring sound which had been going on for about 10 minutes; he imagined the noise to be rather like what Niagara Falls would sound like from a distance of about 3 miles. The occupants of the tent went outside and noticed a large thunder cloud in the vicinity from the edge of which some hailstones fell amongst them. No thunder or lightning was observed and the cloud gradually moved away. He states that the hailstones were flattish or rather like the underside of a button, and in size about the circumference of a penny. The four local residents with him at the time had never previously seen hailstones of a similar type or heard a noise to correspond to the roaring sound.

Another observer about two miles distant and approximately 400 feet higher up, states that at 14h. a violent hailstorm occurred, accompanied by thunder and lightning which lasted about a quarter of an hour. There were a few round hailstones of normal size and some others of peculiar shape, like teeth, with needle-sharp points, but for the most part they were "flattish," rather like an acid drop and about the circumference of a shilling. He cut open a round one and found the usual formation which he described as like a section of an onion. The "flattish" ones when cut open at the sides or centre appeared as one piece of solid ice. The hailstones did not melt rapidly and when they did commence to do so, the flat ones dissolved first from the centre and eventually left a ring of ice on the outside which was the last to go.

H. Moorhead.

The Rainfall of 1930

The rainfall of 1930 over the British Isles as a whole was 115 per cent of the average, thus continuing the remarkable run of wet years already experienced. The last dry year was 1921, since when the accumulated excess of rainfall over the British Isles as a whole has amounted to 90 per cent of the average annual amount. In the last nine years we have received therefore nearly as much rain as falls on the average in 10 years. So long a run of wet years has not occurred since the nine years 1875 to 1883. The accumulated excess during this period was slightly less than that just recorded, being 82 per cent. It is noteworthy that from 1884 to 1902, the rainfall exceeded the average in only five out of 19 years.

The excesses of the last nine years, over the 35 years' average 1881 to 1915, were more pronounced in the summer, the mean percentage excess in the summer months being 13 compared with 8 in the winter. During this period March was the only month in which the mean rainfall of the nine years was less than the average amount (actually 77 per cent), June and December gave the average amount, while January and September were the wettest months, each with 129 per cent of the respective averages. The mean rainfall of the remaining months during the last nine years was between 110 and 115 per cent of the average amounts in each case.

Compared with 1929 the rainfall of the year 1930 presents few points of outstanding interest. Mention may be made, however, of the following incidents. The thunderstorm near Ilkley on April 25th was remarkable in that about 1·84in. of rain and hail fell there in 30 minutes. The thunderstorm rains from June 12th to 19th were also remarkable, especially near Wormwood Scrubs on the 17th, and near Deptford on the 18th. The cyclonic rains of July 20th to 23rd near Whitby were, on the other hand, notable for their persistence. During these four days as much as 11·97in. was recorded at Castleton, in the Yorkshire Wolds. Much damage by flooding resulted in the Esk and Leven Valleys, and an unusual occurrence was the use of the Whitby lifeboat at Ruswarp, two miles inland, where it was launched from its carriage over flooded fields for rescue work. The rainfall at Ross-on-Wye for the period October, 1929, to January, 1930, is also worthy of comment. The total rainfall was 26·88in., or within 1·5in. of the average rainfall for a whole year, and the rainfall was greater than that of any other four months experienced at that station since records began in 1818.

Over the British Isles as a whole, there were five consecutive wet months from July to November. The rainfall during March, April, May and December was in each case fairly close to the average amount. January was unusually wet, while June and especially February were dry. The period February to July was noteworthy for the deficiency of rainfall in Scotland, while there was a remarkable run of six wet months from July to December in Ireland. Provisional general values for the rainfall of 1930, expressed as percentages of the average 1881 to 1915 are:—England and Wales 117, Scotland 110, Ireland 114, British Isles 115. Over the Britsh Isles as a whole 1930 was therefore not quite as wet as 1924, 1927 or 1928. The general percentage values for 1922 to 1929 are given for comparison:—100, 114, 117, 104, 103, 118, 118 and 101.

The total rainfall was less than the average over only a small part of the British Isles. Small deficiencies occurred in the Thames Valley between Newbury and Windsor, in the English Lake District, near Crieff and Grantown-on-Spey, and along the northwest coasts of Scotland and of Ireland. There was rather less than 90 per cent in part of Co. Donegal and over the Outer and Inner Hebrides. Falls of more than 120 per cent were widespread. Such large excesses occurred in the Devon-Cornwall peninsula, over a broad belt stretching across the Pennines from Gloucester and Snowdonia in the west to Flamborough Head and Newcastle in the east, in the southeast of Ireland from Cork to the Wicklow Mountains, in Connemara and locally in Scotland, in Bute, near Dundee, Aberdeen and Eskdalemuir Observatory, Dumfriesshire. Falls of more than 130 per cent were confined to England, Wales and Ireland, and occurred in the northeast of Wales from Flint to Montgomery, in the Wicklow Mountains, and locally near Ashburton, Birmingham, Bradford, the Yorkshire Wolds and Sunderland. Falls of

140 per cent and more were probably confined to the region near Whitby, where the rainfall of July 20th to 23rd was so remarkable.

J. GLASSPOOLE.

Reviews

(1) *Die Münchener Registrierballonfahrten im Jahre* 1928, by P. Zistler and H. Zierl. (2) *Die Temperaturverhältnisse der freien Atmosphäre über München*, by P. Zistler. (3) *Statistische Ubersicht über die Münchener Registrierballonaufstiege*, by P. Zistler. (4) *Singularitäten im jährlichen Witterungsverlaufe von München*, by A. Schmauss. (5) *Klimatologie von Bayern: Erstes und letztes Auftreten bestimmter Temperaturtagesmittel im Jahresverlaufe*, by A. Huber. (6) *Die luftelektrischen Verhältnisse am Zugspitzgipfel in* 2960*m*, by P. Lautner. (7) *Beiträge zum Strahlungsklima der Zugspitze*, by H. Lipp. Deutsch. Meteor. Jahrb. Bayern, 1928.

These papers deal with various aspects of meteorology in south Germany. Paper (1) gives a list of the individual results of registering balloon ascents carried out at Munich in 1928; (2) and (3) summarise the results of all the Munich ascents from 1906-14 and 1922-8, in regard to the temperature distribution and to general wind conditions, respectively. In all 404 ascents are included, of which 318 reached the stratosphere. No attempt is made to theorise, but the completeness of the information presented makes these papers very useful to anyone investigating upper air conditions.

Paper (4) deals with Munich observations over 45 years, from which mean values of the meteorological elements are determined for each day of the year. The elements considered are temperature, wind direction, pressure, precipitation, and weather variability, the last being determined from precipitation figures alone. With such long-period averages it might be expected that the probability curves for any element would be fairly smooth functions of the day of the year; this, however, is found not to be the case, as several irregularities, or singularities, occur. Perhaps the most striking of these is the result that rain appears just twice as likely to occur on August 17th as on August 10th.

Paper (5) is the fifth of a series of papers which began in 1909 dealing with the climatology of south Germany, A rather novel method is used here in presenting the seasonal variations of mean temperature throughout Bavaria, based on long-period observations from 69 stations. The method of representation is to give tables showing the first and last occurrence of daily mean temperatures (in intervals of 5°C.) at different stations, with certain other immediately connected information. A series of eight maps gives a geographical picture of the results for daily means of 15°C. and 20°C. The results presented in this way are likely to be of more convenient application in regard to phenology and agriculture than the more customary mean temperatures and maps of mean isotherms.

Paper (6) comprises an account, including a description of the instruments used, of a series of measurements of the elements of atmospheric electricity carried out at the peak of the Zugspitze over a three-year period (but especially 1927-8), a discussion of the results, their dependence on meteorological conditions, and a comparison with similar measurements at Munich and Potsdam.

The Zugspitze solar observatory is to South Germany what the Mt. Wilson observatory is to Arizona, and publication (7) deals with the results of a year's observations (1926-7) of the direct solar and diffuse sky radiation at the level of the observatory (2962m.). Transmission coefficients of the atmosphere are determined (the derivation of a formula for transmission in terms of air mass and water-vapour content is interesting), and the effects of cloudiness considered. On this last point one would have preferred that contemporaneous sunshine records had been available; as it was, the means for 1911-20 had to be used. The paper is naturally primarily concerned with the local conditions at the Zugspitze, but it is very comprehensive, and contains more than 160 references to other publications. A. F. CROSSLEY.

Correlation between Weather and Crops with Special Reference to Punjab Wheat. By Rao Saheb Mukund V. Unaker, B.A. Ind. Meteor. Mem., Vol. XXV, Part IV, 1929, pp. 145-60, 2 plates. Calcutta, 1929.

It is the practice of many Government Departments to issue at intervals during the growing season estimates of the area sown and the probable yield of the principal crops. These estimates are mainly based on reports received from crop observers and are subject to modification, with the advance of the growing season. The method is a subjective one depending as it does on personal experience and judgment and many attempts have been made to supplement and perhaps in course of time replace the present method by an objective one based on mathematical formulæ embodying the results of research into the relation between weather and crops. Valuable contributions in this direction have already been made by various investigators, notably Shaw, Hooker and Fisher in this country, Wallén in Sweden, Jacob in India, and Moore, Bradford Smith, Kincer and Mattice in America.

The present note is a preliminary attempt to determine by the method of correlation the influence of weather conditions on the area sown and the yield of wheat in the Punjab, and thus to derive formulæ for predicting during each month of the growing season, October to March, the crop prospects. Using data for 35 years, the author calculates the correlation between temperature (using Lahore maximum temperatures) rainfall, and (in the absence of data giving actual consumption of water through irrigation canals) Indus river levels on the one hand, with area sown, gross out-turn and out-turn per unit area on the other. Due allowance is made for secular increase in area sown and net yield owing to general agricultural development.

The author finds that with regard to area sown the most important rainfall is that of September, the correlation coefficient being +0·61, Indus river levels are important too, the correlation with area sown being +0·60 for September, +0·51 for October and +0·41 and +0·29 respectively for November and December. There is a negative correlation between maximum temperatures and area sown indicating that high temperatures in the growing season are unfavourable.

With regard to gross out-turn high coefficients are obtained with Indus river levels, the values ranging from +0·39 in December to +0·72 in March. The influence of rainfall is most marked in September, December and March (correlation coefficient +0·44 in each month).

The author subsequently proceeds to the evaluation of total correlation coefficients between the departures of Punjub wheat data from adopted normals and departures of the combined meteorological elements. The total. correlation coefficients are given in a table together with the partial correlation coefficients on which they are based. Regression equations are obtained and the calculated values of departures from the adopted normals of area sown at the end of October, gross out-turn at the end of January and March and out-turn per unit area at the end of March compared with the actual values during each of 35 seasons. Curves are given, the total correlation coefficients between the actual and calculated curves ranging from 0·67 (gross out-turn at end of January) to 0·75 (gross out-turn at end of March).

Finally, the author compares estimates determined meteorologically and the official forecasts with the final official returns of area sown and out-turn during each of the twelve seasons commencing 1913-4. In the case of area sown, the meteorological estimates at the end of October gave a correlation coefficient of +0·77 with the final official returns and the official forecasts at the end of January a coefficient of +0·91; in the case of gross out-turn, the meteorological estimates at the end of January and March gave coefficients of +0·60 and +0·65 respectively, the coefficient given by the official forecast by the middle of April being +0·86. The author concludes: "Thus meteorological determination though fairly good is not so accurate as the official estimate; but the chief merit of the former is that it is known much earlier and is consequently of great agricultural interest."

P. I. MULHOLLAND.

Obituary

We regret to learn of the death in London at the age of 54 of Vice-Admiral Sir Charles Royds, Assistant Commissioner of Metropolitan Police, who from 1901-4 served as first lieutenant and meteorologist of the " Discovery " in the British Antarctic Expedition.

We also regret to learn of the death, on January 3rd, 1931, at the age of 60, of Mr. William D. Christmas, of Harpenden, whose articles on the yearly and monthly reports and statistics of the weather and especially the rainfall from Rothamsted Experimental Station in *The Times* were well known.

News in Brief

It was announced in the list of New Year Honours that Sir Richard Gregory, D.Sc., LL.D., Emeritus professor of astronomy, Queen's College, London, Editor of *Nature*, has been made a Baronet.

Dr. Hugo Eckener, of Friedrichshafen, has been elected President of Aeroarctic (Gesellsch. z. Erforsch. d. Arktis, mit Luftfahrzeugen), in succession to the late Dr. Fridtjof Nansen.

Errata

December, 1930, p. 255, line 42, *for* "(Fig. 3)" *read* "(Fig. 2)"
December, 1930, plate facing page 255, titles under both Fig. 1 and Fig. 2 *for* " December 2nd, 1930," *read* " December 2nd, 1929."

The Weather of December, 1930

The month of December was mainly rather mild with frequent mists and fogs and a lack of sunshine in many districts. At the beginning of the month a ridge of high pressure across the country gave quiet, dull and dry weather with fog becoming general between the 4th and 6th, keeping the day temperature below the freezing point locally in the English Midlands on the 5th and 6th. The 4th was a sunny day in eastern England and the 3rd in northwest Ireland, 6·9 hrs. being recorded at Gorleston, Clacton, Felixstowe and Margate on the 4th, and 5·5 hrs. at Mallarany (Co. Mayo) on the 3rd. The slow advance of a trough of low pressure from the Atlantic on the 6th preceded a period of unsettled weather, cyclonic conditions continuing until about the 16th. Precipitation though frequent during this period was generally slight in amount except on the 10th and 15th, when 4·10in. fell at Fofanny (Co. Down), 1·75in. at Tynywaum (Glamorgan), and 1·54in. at Newburgh (Dorset) on the 10th, and 1·02in. at Mallarany (Co. Mayo) on the 15th. There were also periods of welcome sunshine, notably on the 9th and 14th. Day temperature did not rise above the freezing point in parts of Scotland and the English Midlands on the 10th and 15th. The sharpest frost of the month was registered on the morning of the 10th, when temperature on the ground fell to 10°F. at Eskdalemuir and 11°F. at Huddersfield, and in the screen to 15°F. at Eskdalemuir and 19°F. at Renfrew. Snow and sleet were general in the Midlands and Scotland from the 9th-12th, and again on the 15th and 16th. Strong winds were associated with the passage of a secondary depression on the 11th. Mist was frequent during this period and developed into widespread fog in the east and Midlands, as anticyclonic conditions became established about the 17th. With the westerly winds temperature rose generally, especially in the north and west, where 57°F. was recorded at Dublin and 56°F. at Aberdeen on the 18th. From the 16th-22nd. the rainfall was practically confined to the west and northwest of the country. The 21st was a sunny day over England, but on the 22nd, when the anticyclone was centred over the country, fog was general and temperature low. From then until the end of the month depressions of increasing intensity approached and crossed the country from the Atlantic bringing generally unsettled weather, heavy rain or snow at times but periods of bright sunshine, with temperature above normal. The Christmas period was mainly mild with rain at times and bright sunshine, although snow fell heavily in parts of northeastern England on the 26th. Gales occurred generally in the west and north on the 26th and 27th and over southern districts on the evening of the 28th; 78 m.p.h. was registered in a gust at Tiree on the 27th and 68 m.p.h. at Scilly on the 28th. Rainfall was heavy in the west and north on th 28th, when 3·25in. fell at Borrowdale (Cumberland) and 2·94in. at Penrhyn (Carnarvon). The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	25	+ 2	Liverpool	28	—15
Aberdeen	38	+ 2	Ross-on-Wye	31	— 9
Dublin	44	— 4	Falmouth	58	+ 3
Birr Castle	41	— 2	Gorleston	41	— 4
Valentia	41	0	Kew	22	—15

Pressure was above normal over northern and eastern Europe, the greater part of the Atlantic and the western United States, the greatest excesses being 11·5mb. at Waigatz, 7·5mb. at Horta, and 5·6mb. at 50°N., 120°W. Pressure was below normal over Iceland, the greater part of the British Isles, southwest Europe (except Portugal), eastern United States, Alaska, and parts of Canada, the greatest deficits being 9·0mb. at Reykjavik, and 3·9mb. at Brest. Temperature was generally above normal over western Europe, as much as 7°F. in Norrland (Sweden). Except for Switzerland, Dalecarlia (Sweden) and parts of the British Isles rainfall was above normal.

The Seine continued to rise during the night of the 1st-2nd, but afterwards fell rapidly. Thick fog occurred in the Meuse Valley from the 4th-6th, during the prevalence of which 67 people died and 150 became ill. The causes of this fatal fog are at present under investigation by the authorities. A violent snowstorm occurred in central Spain on the 17th, while 3in. of snow (the first this winter) fell in Berlin on the same day. During a dense fog in the Kattegat the *Oberon* and *Arcturus* came into collision and many people were drowned. The sea was frozen as far as the horizon at Parnu on the 17th. Thick fog occurred over Holland and northwest Germany on the 19th, 20th and 21st. A thaw set in, in Switzerland on the 27th, but snow was again falling on the 29th.

A severe storm raged between the Balearic Islands and Algeria from the 17th to 20th, doing much damage to shipping especially along the Algerian coast. All telegraphic and telephonic communications were interrupted in Algeria. The total rainfall for Algiers for December was more than twice the normal, and extensive floods occurred in the department of the Oran.

Moderate to heavy rain fell in Victoria and New South Wales, and light to moderate rain in the first part of the month in South Australia and parts of West Australia.

Navigation closed at Quebec on the 23rd. Temperature was mainly above normal in the United States during the first part of the month, but fell considerably below normal during the later part except in the Missouri and Upper Mississippi Valleys and the Lake Region. Rainfall was generally deficient except along parts of the Atlantic coast. Temperature was above normal in the Argentine except during the last week, while precipitation was in excess in the south but near normal in the north.

The special message from Brazil states that the rainfall in the northern regions was generally scarce with 1·81in. below normal, in the central regions irregular with 0·59in. above normal, and in the southern regions plentiful with 2·64in. above normal. Four small anticyclones passed across the country. Crops were generally in good condition, except the cane and cotton crops of the northeast, which were suffering from lack of rain. At Rio de Janeiro pressure was 0·5mb. above normal and temperature equal to normal.

Rainfall, 1930—General Distribution

	Dec.	Year.
England and Wales	99	117
Scotland	97	110
Ireland	101	114
British Isles	99	115

per cent of the average 1881-1915.

Rainfall: December, 1930: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	1·95	82	*Leics* .	Belvoir Castle	2·25	91
Sur .	Reigate, Alvington	2·40	75	*Rut* .	Ridlington	1·96	78
Kent .	Tenterden, Ashenden	2·81	90	*Linc* .	Boston, Skirbeck	1·56	72
,, .	Folkestone, Boro. San.	2·72	...	,, .	Cranwell Aerodrome	1·83	83
,, .	Margate, Cliftonville	1·78	78	,, .	Skegness, Marine Gdns	1·16	53
,, .	Sevenoaks, Speldhurst	2·40	...	,, .	Louth, Westgate	2·13	76
Sus .	Patching Farm	3·41	101	,, .	Brigg, Wrawby St.	1·71	...
,, .	Brighton, Old Steyne	2·49	80	*Notts* .	Worksop, Hodsock	1·83	77
,, .	Heathfield, Barklye	3·85	104	*Derby* .	Derby, L. M. & S. Rly.	1·96	75
Hants .	Ventnor, Roy. Nat. Hos.	3·58	109	,, .	Buxton, Devon Hos.	4·30	76
,, .	Fordingbridge, Oaklnds	4·05	102	*Ches* .	Runcorn, Weston Pt.	4·70	149
,, .	Ovington Rectory	4·48	113	,, .	Nantwich, Dorfold Hall	3·30	...
,, .	Sherborne St. John	2·86	87	*Lancs* .	Manchester, Whit. Pk.	3·13	97
Berks .	Wellington College	2·45	85	,, .	Stonyhurst College	3·58	74
,, .	Newbury, Greenham	3·46	108	,, .	Southport, Hesketh Pk	4·06	126
Herts .	Welwyn Garden City	2·35	...	,, .	Lancaster, Strathspey	5·12	...
Bucks .	High Wycombe	3·58	122	*Yorks* .	Wath-upon-Dearne	1·95	82
Oxf .	Oxford, Mag. College	2·80	121	,, .	Bradford, Lister Pk.	3·08	92
Nor .	Pitsford, Sedgebrook	2·05	85	,, .	Oughtershaw Hall	7·37	...
,, .	Oundle	1·59	...	,, .	Wetherby, Ribston H.	2·52	103
Beds .	Woburn, Crawley Mill	2·28	97	,, .	Hull, Pearson Park	1·91	79
Cam .	Cambridge, Bot. Gdns.	1·86	96	,, .	Holme-on-Spalding	1·73	...
Essex .	Chelmsford, CountyLab	2·37	107	,, .	West Witton, Ivy Ho.	4·32	118
,, .	Lexden Hill House	2·04	...	,, .	Felixkirk, Mt. St. John	2·78	115
Suff .	Hawkedon Rectory	2·26	93	,, .	Pickering, Hungate	2·06	82
,, .	Haughley House	2·06	...	,, .	Scarborough	2·13	89
Norf .	Norwich, Eaton	1·91	73	,, .	Middlesbrough	1·78	92
,, .	Wells, Holkham Hall	1·57	76	,, .	Baldersdale, Hury Res.	3·24	...
,, .	Little Dunham	2·24	92	*Durh* .	Ushaw College	2·88	115
Wilts .	Devizes, Highclere	3·28	107	*Nor* .	Newcastle, Town Moor	...	...
,, .	Bishops Cannings	3·36	102	,, .	Bellingham, Highgreen	2·98	82
Dor .	Evershot, Melbury Ho.	5·49	106	,, .	Lilburn Tower Gdns.	3·74	139
,, .	Creech Grange	5·27	119	*Cumb* .	Geltsdale	2·72	...
,, .	Shaftesbury, Abbey Ho.	3·63	100	,, .	Carlisle, Scaleby Hall	2·04	64
Devon .	Plymouth, The Hoe	4·78	96	,, .	Borrowdale, Seathwaite	11·75	72
,, .	Polapit Tamar	...	...	,, .	Borrowdale, Rosthwaite	10·87	...
,, .	Ashburton, Druid Ho.	...	...	,, .	Keswick, High Hill	5·74	...
,, .	Cullompton	4·50	103	*Glam* .	Cardiff, Ely P. Stn.	4·35	85
,, .	Sidmouth, Sidmount	4·02	102	,, .	Treherbert, Tynywaun	10·35	...
,, .	Filleigh, Castle Hill	6·70	...	*Carm* .	Carmarthen Friary	7·33	128
,, .	Barnstable, N. Dev. Ath.	6·04	136	,, .	Llanwrda	7·46	106
Corn .	Redruth, Trewirgie	3·92	63	*Pemb* .	Haverfordwest, School	6·96	122
,, .	Penzance, Morrab Gdn.	4·43	78	*Card* .	Aberystwyth	6·77	...
,, .	St. Austell, Trevarna	5·30	87	,, .	Cardigan, County Sch.	6·52	...
Soms .	Chewton Mendip	4·64	86	*Brec* .	Crickhowell, Talymaes	6·10	...
,, .	Long Ashton	3·73	97	*Rad* .	Birm W. W. Tyrmynydd	8·39	102
,, .	Street, Millfield	3·03	...	*Mont* .	Lake Vyrnwy	9·12	133
Glos. .	Cirencester, Gwynfa	3·60	107	*Denb* .	Llangynhafal	4·97	151
Here .	Ross, Birchlea	2·53	85	*Mer* .	Dolgelly, Bryntirion	9·58	140
,, .	Ledbury, Underdown	3·36	120	*Carn* .	Llandudno	4·50	145
Salop .	Church Stretton	4·48	133	,, .	Snowdon, L. Llydaw 9	20·70	...
,, .	Shifnal, Hatton Grange	2·89	112	*Ang* .	Holyhead, Salt Island	5·13	123
Worc .	Ombersley, Holt Lock	...	...	,, .	Lligwy	5·93	149
,, .	Blockley	3·61	...	*Isle of Man*			
War .	Farnborough	...	...		Douglas, Boro' Cem.	7·05	142
,, .	Birminghm, Edgbaston	2·89	107	*Guernsey*			
Leics .	Thornton Reservoir	2·21	82		St. Peter P't. Grange Rd.	4·92	120

Rainfall: December, 1930: Scotland and Ireland

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Wigt .	Pt. William, Monreith	5·18	114	*Suth* .	Loch More, Achfary	8·00	87
,, .	New Luce School	5·22	94	*Caith* .	Wick	2·04	66
Kirk .	Carsphairn, Shiel	8·43	91	*Ork* .	Pomona, Deerness	3·72	89
Dumf .	Dumfries, Crichton, R.I	4·40	...	*Shet* .	Lerwick	5·48	115
,, .	Eskdalemuir Obs.	5·37	77	*Cork* .	Caheragh Rectory	5·95	...
Roxb .	Branxholm	3·68	101	,, .	Dunmanway Rectory	6·09	76
Selk .	Ettrick Manse	5·70	92	,, .	Ballinacurra	...	...
Peeb .	West Linton	2·32	...	,, .	Glanmire, Lota Lo.	4·45	81
Berk .	Marchmont House	2·69	96	*Kerry* .	Valentia Obsy.	6·27	94
Hadd .	North Berwick Res.	1·27	59	,, .	Gearahameen	11·10	...
Midl .	Edinburgh, Roy. Obs.	1·63	76	,, .	Killarney Asylum	6·40	88
Ayr .	Kilmarnock, Agric. C.	4·02	94	,, .	Darrynane Abbey	7·61	129
,, .	Girvan, Pinmore	5·49	92	*Wat* .	Waterford, Brook Lo.	4·54	97
Renf .	Glasgow, Queen's Pk.	3·55	84	*Tip* .	Nenagh, Cas. Lough	4·66	101
,, .	Greenock, Prospect H.	6·97	88	,, .	Roscrea, Timoney Park	4·03	...
Bute .	Rothesay, Ardencraig.	7·67	141	,, .	Cashel, Ballinamona	3·87	89
,, .	Dougarie Lodge	5·38	...	*Lim* .	Foynes, Coolnanes	5·18	110
Arg .	Ardgour House	9·74	...	,, .	Castleconnel Rec.	4·76	...
,, .	Manse of Glenorchy	8·90	...	*Clare* .	Inagh, Mount Callan	7·84	...
,, .	Oban	6·49	96	,, .	Broadford, Hurdlest'n.	5·08	...
,, .	Poltalloch	7·26	114	*Wexf* .	Gorey, Courtown Ho.	4·51	118
,, .	Inveraray Castle	7·60	77	*Kilk* .	Kilkenny Castle	3·63	105
,, .	Islay, Eallabus	8·43	142	*Wic* .	Rathnew, Clonmannon	4·51	...
,, .	Mull, Benmore	...	...	*Carl* .	Hacketstown Rectory	4·07	99
,, .	Tiree	6·34	...	*Leix* .	Blandsfort House	4·90	133
Kinr .	Loch Leven Sluice	2·71	69	,, .	Mountmellick	...	...
Perth .	Loch Dhu	8·90	88	*Off'ly* .	Birr Castle	3·45	105
,, .	Balquhidder, Stronvar	6·63	...	*Kild'r* .	Monasterevin	...	...
,, .	Crieff, Strathearn Hyd.	5·29	118	*Dubl* .	Dublin, FitzWm. Sq.	2·53	102
,, .	Blair Castle Gardens	4·62	121	,, .	Balbriggan, Ardgillan.	4·02	139
,, .	Glen Bruar, Bruar Ldg.	5·04	...	*Me'th* .	Beauparc, St. Cloud	3·56	...
Angus .	Kettins School.	4·75	159	,, .	Kells, Headfort	3·75	98
,, .	Dundee, E. Necropolis	2·95	111	*W.M* .	Moate, Coolatore	3·77	...
,, .	Pearsie House	4·98	...	,, .	Mullingar, Belvedere	4·06	110
,, .	Montrose, Sunnyside	3·65	131	*Long* .	Castle Forbes Gdns.	3·85	97
Aber .	Braemar, Bank	4·55	128	*Gal* .	Ballynahinch Castle	9·76	130
,, .	Logie Coldstone Sch.	2·85	101	,, .	Galway, Grammar Sch.	4·78	...
,, .	Aberdeen, King's Coll.	3·96	123	*Mayo* .	Mallaranny	8·42	...
,, .	Fyvie Castle	3·37	99	,, .	Westport House	6·13	107
Moray .	Gordon Castle	1·63	61	,, .	Delphi Lodge	11·36	94
,, .	Grantown-on-Spey	2·08	77	*Sligo* .	Markree Obsy.	4·91	104
Nairn .	Nairn, Delnies	1·96	88	*Cav'n* .	Belturbet, Cloverhill	3·16	85
Inv .	Kingussie, The Birches	2·09	...	*Ferm* .	Enniskillen, Portora	...	...
,, .	Loch Quoich, Loan	15·47	...	*Arm* .	Armagh Obsy.	2·58	83
,, .	Glenquoich	12·50	85	*Down* .	Fofanny Reservoir	12·37	...
,, .	Inverness, Culduthel R.	...	...	,, .	Seaforde	3·85	94
,, .	Arisaig, Faire-na-Squir	6·39	...	,, .	Donaghadee, C. Stn.	3·37	106
,, .	Fort William	7·68	...	,, .	Banbridge, Milltown	2·85	...
,, .	Skye, Dunvegan	8·49	...	*Antr* .	Belfast, Cavehill Rd.	3·48	...
R & C.	Alness, Ardross Cas	3·27	79	,, .	Glenarm Castle	3·78	...
,, .	Ullapool	5·48	87	,, .	Ballymena, Harryville	4·04	91
,, .	Torridon, Bendamph.	7·68	75	*Lon* .	Londonderry, Creggan	4·38	100
,, .	Achnashellach	6·61	...	*Tyr* .	Donaghmore	3·94	...
,, .	Stornoway	4·87	78	,, .	Omagh, Edenfel	4·40	104
Suth .	Lairg	2·34	58	*Don* .	Malin Head	4·10	...
,, .	Tongue	2·76	56	,, .	Dunfanaghy	4·36	...
,, .	Melvich	4·11	...	,, .	Killybegs, Rockmount.	4·59	63

Climatological Table for the British Empire, July, 1930.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb							
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy. ..	1011·3	— 4·5	81	48	69·3	54·5	61·9	— 0·8	55·5	79	6·9	1·84	— 0·33	14	5·6	35
Gibraltar............	1015·3	— 1·5	88	55	83·2	64·1	73·7	— 1·1	63·0	81	2·3	0·00	— 0·03	0	..	..
Malta	1013·8	— 1·5	93	68	84·4	72·1	78·3	0·0	71·0	71	1·5	0·04	— 0·01	1	12·7	89
St. Helena	1017·8	+ 1·4	..	53	..	54·8	..	..	56·0	95	9·4	4·86	+ 0·83	28	..	..
Sierra Leone	1015·0	+ 2·3	86	67	81·5	71·3	76·4	— 2·2	75·7	91	7·7	29·43	— 6·15	25	..	..
Lagos, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland ..	1018·0	— 0·5	78	48	71·2	52·8	62·0	0·0	..	82	4·8	0·25	— 0·10	4	..	..
Salisbury, Rhodesia ..	1019·6	— 0·2	75	35	68·6	42·7	55·7	— 0·4	47·7	47	1·6	0·00	— 0·03	0	9·2	82
Cape Town	1022·6	+ 1·3	84	44	63·8	50·6	57·2	+ 2·5	50·2	83	5·2	2·64	— 0·98	15	..	..
Johannesburg........	1023·8	— 0·2	68	30	60·4	42·1	51·3	+ 0·8	39·5	39	1·1	1·00	+ 0·67	2	9·2	86
Mauritius	1020·0	— 0·4	79	55	74·3	62·8	68·5	+ 0·2	65·3	73	5·1	1·49	— 1·00	14	7·3	66
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calcutta, Alipore Obsy.	999·3	+ 0·1	95	76	88·6	78·9	83·7	+ 0·2	79·3	90	9·0	20·12	+ 7·61	20*	..	..
Bombay	1005·1	+ 1·2	88	74	85·5	76·7	81·1	— 0·2	77·3	84	8·9	10·26	— 14·01	25*	..	..
Madras	1004·8	+ 0·3	102	75	97·8	80·5	89·1	+ 1·7	74·6	58	6·2	1·13	— 2·81	2*	..	..
Colombo, Ceylon	1010·0	+ 0·8	86	72	84·9	77.9	81·4	+ 0·3	77·0	78	7·5	1·12	— 5·31	11	7·5	60
Hongkong	1001·0	— 3·8	93	74	86·8	78·5	82·7	+ 0·2	78·6	83	7·9	29·03	+ 15·65	22	5·7	42
Sandakan	..	..	94	72	89·9	74·8	82·3	+ 0·5	77·0	79	..	3·95	— 2·60	9	..	..
Sydney, N.S.W.	1017·9	— 0·6	69	43	63·4	48·4	55·9	+ 3·2	49·7	80	4·7	3·93	— 0·91	11	5·7	56
Melbourne	1017·6	— 1·5	63	36	57·7	44·5	51·1	+ 2·5	47·4	74	6·1	1·48	— 0·35	17	3·8	38
Adelaide	1018·6	— 1·8	66	41	61·2	48·8	55·0	+ 3·3	49·7	79	7·5	4·22	+ 1·57	21	4·3	43
Perth, W. Australia ..	1017·2	— 1·8	70	41	63·9	48·6	56·3	+ 1·1	51·4	77	5·9	10·17	+ 3·72	21	5·1	50
Coolgardie	1018·8	— 1·1	74	33	62·2	40·8	51·5	+ 0·3	46·7	69	2·8	0·25	— 0·66	5	..	..
Brisbane	1019·3	+ 0·8	75	42	69·1	51·9	60·5	+ 2·0	54·5	71	4·3	1·25	— 1·09	9	6·7	63
Hobart, Tasmania....	1012·7	— 1·1	60	36	55·4	43·8	49·6	+ 4·2	44·4	77	6·3	2·27	+ 0·13	14	3·9	41
Wellington, N.Z.	1016·4	+ 2·5	57	32	49·4	38·9	44·1	— 3·6	41·7	84	7·0	3·71	— 1·92	23	3·5	37
Suva, Fiji	1013·6	— 0·6	83	62	76·3	67·7	72·0	— 1·6	67·2	76	6·9	3·46	— 1·14	20	3·9	35
Apia, Samoa	1010·8	— 1·2	86	69	83·3	73·4	78·4	+ 1·2	76·3	78	4·4	0·87	— 1·77	6	8·3	73
Kingston, Jamaica....	1014·2	— 0·5	93	71	89·5	74·1	81·8	+ 0·1	72·4	77	4·7	0·33	— 1·29	6	7·1	54
Grenada, W.I.	1013·5	+ 0·3	89	71	87·0	73·6	80·3	+ 1·3	73·9	77	4·8	6·65	— 3·14	22	..	..
Toronto	1013·3	— 0·8	92	50	80·9	59·2	70·1	+ 1·9	61·1	65	3·0	3·10	+ 0·06	7	10·5	70
Winnipeg	1012·6	— 0·1	94	51	81·9	59·7	70·8	+ 4·6	60·7	84	4·0	5·22	+ 2·06	9	11·1	70
St. John, N.B.	1011·4	— 2·3	81	51	71·0	55·8	63·4	+ 3·0	59·3	83	7·5	5·34	+ 1·71	18	6·4	42
Victoria, B.C.	1018·6	+ 1·9	87	48	67·0	51·3	59·1	— 1·2	54·6	73	4·0	0·03	— 0·33	1	11·7	75

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.